

PATENT APPLICATION**MATERIALS, EQUIPMENT AND METHODS FOR MANUFACTURING
CIGARETTES****FIELD OF THE INVENTION**

The present invention relates to smoking articles, and in particular, to equipment, materials and techniques used for the manufacture of those smoking articles. More specifically, the present invention relates to the manufacture of cigarette rods, and in particular, to systems and methods for applying an additive material to desired locations of wrapping materials of cigarettes in an efficient, effective and desired manner.

BACKGROUND OF THE INVENTION

Smoking articles, such as cigarettes, have a substantially cylindrical rod-shaped structure and include a charge, roll, or column of smokable material, such as shredded tobacco, surrounded by a paper wrapper, to form a "cigarette rod," "smokable rod" or a "tobacco rod." Normally, a cigarette has a cylindrical filter element aligned in an end-to-end relationship with the tobacco rod. Typically, a filter element comprises plasticized cellulose acetate tow circumscribed by a paper material known as "plug wrap." Certain cigarettes incorporate filter elements comprising, for example, activated charcoal particles. Typically, the filter element is attached to one end of the tobacco rod using a circumscribing wrapping material known as "tipping paper."

A cigarette is used by a smoker by lighting one end of that cigarette, and burning the tobacco rod. The smoker then receives mainstream smoke into his or her mouth by drawing on the opposite end of the cigarette. During the time that the cigarette is not being drawn upon by the smoker, the cigarette remains burning.

Numerous attempts have been made to control the manner that a cigarette burns when the cigarette is not being drawn upon. For example, cigarette papers have been treated with various materials to cause cigarettes incorporating those papers to self extinguish during periods when those cigarettes are lit but are not being actively puffed. Certain treatment methods have involved applying materials to the paper in circumferential bands or longitudinal stripes, creating

1 areas that affect the burn rate of cigarettes incorporating that cigarette papers. See, for example,
2 U.S. Patent Nos. 3,030,963 to Cohn; 4,146,040 to Cohn; 4,489,738 to Simon; 4,489,650 to
3 Weinert; and 4,615,345 to Durocher; U.S. Patent Application 2002/0185143 to Crooks et al.;
4 U.S. Patent Application 2003/0145869 to Kitao et al.; U.S. Patent Application 2003/0150466 to
5 Kitao et al.; and U.S. Patent Application Serial No. 09/892,834, filed June 27, 2001. In addition,
6 numerous references disclose applying films to the paper wrapping materials of tobacco rods.
7 See, for example, U.S. Patent Nos. 1,909,924 to Schweitzer; 4,607,647 to Dashley; and
8 5,060,675 to Milford et al.; and U.S. Patent Application 2003/0131860 to Ashcraft et al.

9 "Banded" paper wrapping materials that are used for cigarette manufacture possess
10 segments defined by the composition, location, and properties of the various materials within
11 those wrapping materials. Numerous references contain disclosures suggesting various banded
12 wrapping material configurations. See, for example, U.S. Patent Nos. 1,996,002 to Seaman;
13 2,013,508 to Seaman; 4,452,259 to Norman et al.; 5,417,228 to Baldwin et al.; 5,878,753 to
14 Peterson et al.; 5,878,754 to Peterson et al.; and 6,198,537 to Bokelman et al.; and PCT WO
15 02/37991. Methods for manufacturing banded-type wrapping materials also have been
16 disclosed. See, for example, U.S. Patent Nos. 4,739,775 to Hampl, Jr. et al.; and 5,474,095 to
17 Allen et al.; and PCT WO 02/44700 and PCT WO 02/055294. Some of those references
18 describe banded papers having segments of paper, fibrous cellulosic material, or particulate
19 material adhered to a paper web. See, U.S. Patent Nos. 5,263,999 to Baldwin et al.; 5,417,228 to
20 Baldwin et al.; and 5,450,863 to Collins et al.; and U.S. Patent Application 2002/0092621 to
21 Suzuki. Methods for manufacturing cigarettes having treated wrapping materials are set forth in
22 U.S. Patent Nos. 5,191,906 to Myracle, Jr. et al. and PCT WO 02/19848.

23 Additive materials can be applied to cigarette paper wrapping materials during the time
24 that those wrapping materials are being used for cigarette manufacture (i.e., in a so-called "on-
25 line" fashion). However, water-based formulations incorporating those additives, and the paper
26 wrappers to which the additives are applied, have a tendency to remain wet when the additive-
27 treated wrapper reaches the garniture section of the cigarette making machine. Consequently, for
28 example, the additive materials that are applied to a paper web tend to rub off of the paper and
29 onto components of the finger rail assembly that is located near the garniture end of the suction
30 rod conveyor of the cigarette making machine, and onto the tongue and folder components that
31 are located in the garniture region of the cigarette making machine. A build-up of additive

1 material on certain regions of the cigarette making machine can cause cigarette rod formation
2 problems, paper breaks, and machine downtime for cleaning. Such an undesirable tendency for
3 additive materials to transfer from the paper web to surfaces of the cigarette machine is increased
4 with increasing speed of manufacture of the continuous cigarette rod.

5 Several references have proposed modifications to the garniture regions of cigarette
6 making machines. Several of those references propose introducing certain substances into a
7 cigarette making machine during cigarette rod manufacture. For example, U.S. Patent No.
8 4,186,754 to Labbe discloses feeding water or alcohol to the surface of the tongue which
9 contacts the stream of a particular type of tobacco in order address concerns of gummy
10 substances that reportedly build up on that tongue. U.S. Patent No. 4,409,995 to Nichols
11 discloses applying a flavorant in particulate or liquid form to a cigarette rod through the tongue
12 region of a cigarette making machine. U.S. Patent No. 4,619,276 to Albertson et al. discloses
13 applying foamed flavorant to a cigarette rod through the tongue region of a cigarette making
14 machine. U.S. Patent No. 4,899,765 to Davis et al. discloses a process for introducing liquid into
15 the garniture tongue in liquid outlet openings.

16 It would be desirable to apply additive material in a controlled manner as a predetermined
17 pattern (e.g., as bands) to a continuous strip of wrapping material of the type that is used for the
18 manufacture of smokable rods. As such, it would be desirable to supply a continuous strip of
19 paper web from a roll, apply additive material to that paper strip, and wind that resulting treated
20 paper web on a roll for later use on an automated cigarette making machine (i.e., it would be
21 desirable to provide treated wrapping material in a so-called "off-line" fashion). It also would be
22 highly desirable to provide cigarettes having predetermined patterns of additive materials (e.g.,
23 as bands) applied in desired locations to the wrapping materials of those cigarettes, particularly
24 using on-line processes during cigarette manufacture. It also would be desirable to apply
25 additive materials to a continuous web of a wrapping material of a tobacco rod in an efficient and
26 effective manner during the manufacture of that tobacco rod. It also would be desirable to
27 ensure that the wrapping material so treated with additive material meets standards of quality
28 desired by the manufacturer of those tobacco rods. It also would be desirable to provide a
29 method for minimizing or preventing transfer of an additive material on a paper web to a
30 cigarette making machine surface; and it also would be desirable that such method operate

effectively and be easily implemented within a conventional automated cigarette making machine of the type used to produce commercial quantities of cigarettes.

SUMMARY OF THE INVENTION

The present invention provides systems, apparatus, and methods for manufacturing smoking articles, such as cigarettes. Certain preferred aspect of the present invention relate to suitable additive materials, such as water-based, starch-based formulations. Certain preferred aspects of the present invention relate to manners and methods for transferring additive material to, and retaining an additive material on desired locations of, a wrapping material (e.g., paper wrapping web) that is wound onto a roll for later use for smoking article manufacture. Certain preferred aspects of the present invention relate to manners and methods for transferring additive material to, and retaining an additive material on desired locations of, a wrapping material suitable for use for smoking article manufacture (e.g., paper wrapping web) when manufacturing smoking articles from those materials using a cigarette making machine. That is, preferred aspects of the present invention comprise various embodiments of an apparatus for applying an additive material (e.g., as an adhesive-type of formulation) to a continuous advancing strip of a paper web within a region of an automated cigarette making machine system (e.g., a machine designed to produce a continuous cigarette rod). In the highly preferred aspects of the present invention, an additive material is applied to a paper web in an on-line fashion (i.e., using a cigarette making machine or a component of a cigarette making machine assembly during cigarette manufacturing process). In the most highly preferred aspects of the present invention, the automated cigarette making machine can operate so as to apply a desired additive material, in a desired amount, in a desired configuration, in a desired location, on a continuous strip of paper wrapping material used for the manufacture of a continuous cigarette rod; which strip of paper wrapping material is supplied (and hence the continuous cigarette rod is manufactured) at speeds exceeding about 350 meters per minute, and often at speed exceeding about 400 meters per minute.

Certain cigarette making apparatus and systems of the present invention are characterized as single component systems. A continuous paper web is provided from a source (e.g., a bobbin) associated with a component of such a system (e.g., an unwind spindle assembly of that system). Tobacco filler and components for manufacturing a continuous cigarette rod from the tobacco

1 filler and the continuous paper web are provided using the same component of that system (e.g.,
2 using an upwardly moving air stream coupled with a conveyor system and a garniture system,
3 respectively). Such cigarette making apparatus can be adapted to incorporate additive
4 application apparatus that provide ways to apply additive material (e.g., coating formulations) to
5 the continuous paper web in an on-line fashion.

6 Certain cigarette making apparatus and systems of the present invention are characterized
7 as multi-component systems, and in particular, two component systems. A continuous paper
8 web is provided from a source that is the first component of such a system. Tobacco filler and
9 components for manufacturing a continuous cigarette rod from the tobacco filler and the
10 continuous paper web supplied by the first component are provided using the second component
11 of that system. For preferred two component systems, the two components are independent,
12 stand alone units. Such cigarette making apparatus can be adapted to incorporate additive
13 application apparatus that provide ways to apply additive material (e.g., coating formulations) to
14 the continuous paper web in an on-line fashion.

15 In one aspect, the present invention relates to equipment and methods for applying an
16 additive material to a substrate, such as a paper web used as a wrapping material for cigarette
17 manufacture. Those equipment and methods are particularly suitable in connection with the
18 operation of an automated cigarette making machine, and for the purpose of applying a
19 predetermined pattern of additive material to a continuous strip of paper web. An additive
20 application apparatus includes a first roller adapted to receive the additive material (e.g., a
21 coating formulation in liquid form) and a second roller adjacent to the first roller adapted to
22 transfer the additive material from the first roller to the substrate (e.g., paper web). That
23 apparatus also includes an additive material reservoir adjacent to the first roller for containing the
24 additive material, and for supplying the additive material to the first roller. The additive material
25 so supplied is positioned within pockets, grooves or indentations within the roll face of the first
26 roller. For that apparatus, the roll face of the second roller is in roll contact with the roll face of
27 the first roller in one location, and the roll face of the second roller is in contact with the paper
28 web in another location; thus allowing for a predetermined transfer of additive material in a two-
29 step manner. That is, when the additive material is supplied to pockets within the roll face of the
30 first roller, that additive material is transferred to the roll face of the second roller; and when the

1 second roller contacts the advancing paper web, the additive material is transferred from the roll
2 face of the second roller and applied to the advancing paper web.

3 For the foregoing additive application apparatus, appropriate roll contact between the roll
4 faces of the respective rollers is facilitated by a pressure plate, or other suitable means for
5 ensuring contact of the second roller with the first roller. As such, the first roller is moved, or
6 otherwise arranged or positioned, into operative rotating engagement with the second roller.
7 Thus, in certain embodiments, such as when the first and second rollers both are located on the
8 same side of the paper web, and when the first and second rollers are in appropriate roll contact,
9 the additive material is transferred from the first roller to the second roller in virtually the same
10 type of pattern as the pattern dictated by the location the pockets on the first roller. Contact of
11 the second roller with the paper web is provided using a roller lift bracket, or other suitable
12 means for facilitating contact of the second roller with the paper web. The roller lift bracket
13 includes a plurality of guide rollers, and the bracket is movable (e.g., preferably is slidable up
14 and down), so as to cause movement of those rollers into rotating roll contact with the paper web
15 and the paper web into contact with the second roller. Thus, when the paper web contacts the
16 second roller, the additive material is transferred from the second roller to the paper web in
17 essentially the same pattern as the pattern dictated by the location of the pockets on the first
18 roller (i.e., the pattern corresponds to the pattern of the pockets on the roll face of the first roller).
19 As such, a suitable method for applying additive material to a web of wrapping material, most
20 preferably in an on-line fashion, is provided.

21 In another embodiment of an additive application apparatus, additive material (e.g., a
22 coating formulation in paste form) is applied to a substrate (e.g., a paper web) using a system that
23 employs a first roller adapted to (i) receive an additive material from an additive material
24 reservoir, and (ii) apply that additive material to the substrate. Preferably, the first roller
25 comprises a plurality of pockets, grooves or indentations that are aligned or arranged in the form
26 of a pattern on the roll face of that roller. When the additive material is supplied to the first
27 roller, a predetermined amount of the additive material is contained in each of the plurality of
28 pockets. A second roller is in roll contact with the first roller, and the paper web passes through
29 the location or region where those two rollers make roll contact. Such roll contact facilitates
30 transfer of the additive material from the first roller to the paper web.

1 For the foregoing additive application apparatus, the second roller is connected to the
2 roller lift bracket and is thus positioned on the side of the paper web opposite the first roller. The
3 roller lift bracket preferably is movable, and as such provides a means to cause movement of the
4 second roller into, and out of, rotating contact with both the paper web and the first roller. In this
5 manner, the roller lift bracket provides both (i) a way to provide contact of the second roller with
6 the first roller, and (ii) a way to provide contact of the second roller with the paper web. Thus,
7 when the paper web comes into contact between the first and second rollers in the nip region or
8 location between those rollers, the additive material is transferred from the first roller to the
9 paper web in essentially the same pattern as the pattern dictated by the location of the pockets on
10 the first roller (i.e., the pattern corresponds to the pattern of the pockets on the roll face of the
11 first roller). As such, a suitable method for applying additive material to a web of wrapping
12 material, most preferably in an on-line fashion, is provided.

13 Another additive application apparatus includes a first roller adapted to receive the
14 additive material (e.g., a coating formulation in liquid form) and a second roller adjacent to the
15 first roller adapted to transfer the additive material from the first roller to a substrate (e.g.,
16 continuous advancing paper web). That apparatus also includes an additive material reservoir
17 adjacent to the first roller for containing the additive material, and for supplying the additive
18 material to the first roller. The additive material so supplied is positioned on the roll face of the
19 first roller. For that apparatus, the roll faces of protruding dies extending from the second roller
20 are in roll contact with the roll face of the first roller in one location; and the roll faces of the
21 protruding dies of the second roller are in contact with the paper web in another location; thus
22 allowing for a predetermined transfer of additive material in a two-step manner. That is, when
23 the additive material is supplied to the roll face of the first roller, that additive material is
24 transferred to the roll face of the protruding dies of the second roller; and when those dies
25 possessing additive material on their roll faces contact the advancing paper web, the additive
26 material is transferred from the roll face of the protruding dies of the second roller and applied to
27 the advancing paper web. As such, a suitable method for applying additive material to a web of
28 wrapping material, most preferably in an on-line fashion, is provided.

29 Another additive application apparatus includes a first roller adapted to receive the
30 additive material (e.g., a coating formulation in liquid form) on at least a portion of its roll face, a
31 second roller adjacent to the first roller adapted to receive the additive material to at least a

1 portion of its roll face, and an application roller adapted to (i) receive the additive material to
2 desired locations on the roll face thereof from the roll face of the second roller, and (ii) apply that
3 additive material to a substrate (e.g., continuous advancing paper web). That apparatus also
4 includes an additive material reservoir adjacent to the first roller for containing the additive
5 material, and for supplying the additive material to a desired location of the roll face of the first
6 roller (e.g., a continuous groove circumscribing a portion of the roll face of that first roller). As
7 such, the additive material so supplied is continuously positioned on a predetermined region of
8 the roll face of the first roller; and as a result of the roll interaction of the first and second rollers,
9 additive material is applied to a predetermined region of the roll face of the second roller. The
10 roll faces of protruding dies extending from the application roller are in roll contact with the roll
11 face of the second roller in one location; and the roll faces of the protruding dies of the
12 application roller are in contact with the paper web in another location. Thus, there is provided a
13 manner or method for carrying out a predetermined transfer of additive material in a multi-step
14 manner. That is, additive material is supplied to the roll face of a second roller as a result of roll
15 interaction of a first roller and that second roller, and that additive material on the roll face of the
16 second roller is transferred to predetermined locations on the roll face of the application roller.
17 When those locations of the application roller (e.g., those dies possessing additive material on
18 their roll faces) subsequently contact the advancing paper web, the additive material is
19 transferred from the roll face of the application roller and applied to the advancing paper web.
20 As such, a suitable method for applying additive material to a web of wrapping material, most
21 preferably in an on-line fashion, is provided.

22 Another additive application apparatus includes a first roller adapted to receive the
23 additive material (e.g., a coating formulation in liquid form) and adapted to transfer the additive
24 material to a substrate (e.g., a continuous advancing paper web). The paper web passes between
25 the roll faces of the first roller and a second roller. That apparatus also includes an additive
26 material reservoir adjacent to the first roller for containing the additive material, and for
27 supplying the additive material to the first roller. The additive material so supplied is positioned
28 on the roll face of the first roller. For that apparatus, the roll faces of protrusions or cams
29 extending from the second roller are in roll contact with the roll face of the first roller, and the
30 paper web passes between those roll faces such that both rollers are periodically in contact with
31 the paper web; thus allowing for a predetermined transfer of additive material to the paper web

1 from the roll face of the first roller when the roll faces of the protruding cams of the second roller
2 cause the application of force to the paper web. That is, when the additive material is supplied to
3 the roll face of the first roller, that additive material is transferred to predetermined locations on
4 the surface of the paper web when the protruding cams of the second roller cause the paper web
5 to be pushed against the roll face of the first roller. As such, a suitable method for applying
6 additive material to a web of wrapping material, most preferably in an on-line fashion, is
7 provided.

8 The present invention, in another aspect, relates to a system useful for retaining on a
9 paper web an additive material that has been applied to that paper web. The additive material
10 can be a material that is applied to the paper web in a previous processing step, such as using
11 gravure printing techniques (e.g., using so-called "off-line" techniques), or while that paper web
12 is being used for the manufacture of cigarettes within a cigarette making machine (e.g., using on-
13 line techniques). The system most preferably is located in the garniture entrance region of the
14 cigarette making machine, and particularly in the finger rail region of the cigarette making
15 machine. The system comprises a finger rail assembly and a garniture entrance cone, which are
16 located in a region of the cigarette making machine adapted to receive a continuous paper web.
17 The paper web is advanced between the lower region of the finger rail assembly and the upper
18 region of the garniture entrance cone. The system includes at least one air chamber (e.g.,
19 preferably each finger rail of the finger rail assembly includes an air chamber) located above the
20 advancing paper web and a supply of pressurized or compressed gas (e.g., air) is fed into that air
21 chamber (e.g., a manifold or tubular channel). The air chamber includes a plurality of air
22 distribution outlets or air passageways directed toward the lower surface of the system, and as
23 such, air flows out of the air chamber. When a high velocity stream of air exits the air
24 distribution outlets and is directed generally downward, a zone of air turbulence preferably is
25 created above the advancing paper web. That turbulence provides downward force that
26 maintains the paper web a distance away from (e.g., spaced from) the finger rail assembly of the
27 cigarette making machine. As a result, the additive material is retained on the paper web, and
28 undesirable transfer of the additive material to the finger rail components of the cigarette making
29 machine (and other regions of the cigarette making machine) is minimized, avoided or
30 prevented.

1 The present invention, in another aspect, relates to another system useful for retaining on
2 a paper web an additive material that has been applied to that paper web. That system
3 encompasses modification of a garniture entrance cone (which is designed to be positioned
4 below the advancing paper web within a cigarette making machine). An entrance cone of one
5 aspect of the present invention is adapted to possess an air chamber. That air chamber (e.g.,
6 manifold) is adapted to receive a flow or stream of gas (e.g., air) from a supply of pressurized or
7 compressed air. Two air channels, both providing air outlets, or other suitably adapted air
8 distribution means, are directed generally longitudinally, and are designed so as to provide a flow
9 of air generally upwardly and generally outwardly. As a result, for each of opposing edges of the
10 paper web (i.e., the right and left sides of the paper web relative to the longitudinal axis of that
11 web) that pass over that entrance cone, the stream of air exiting each channel creates a zone of
12 low air pressure zone between that paper web and the upper surface of the entrance cone. Each
13 of the paper web edges is affected by this low pressure zone, and each edge is urged toward the
14 entrance cone and away from the finger rail components of the cigarette making machine (and
15 other regions of the cigarette making machine). As a result, contact of the paper web and
16 additive material with certain components of the cigarette making machine is minimized,
17 avoided or prevented.

18 In one embodiment of the foregoing, an apparatus for the manufacture of cigarettes is
19 adapted to minimize, avoid or prevent transfer of an additive material applied to a paper web
20 from that paper web to surfaces of certain components of that apparatus. The apparatus includes
21 a finger rail assembly comprising a pair of finger rails positioned at the distal, or exit, end of a
22 suction rod conveyor system. The apparatus also includes a garniture entrance cone positioned
23 below the pair of finger rails, essentially as is conventional in a commercially available
24 automated cigarette making machine. The pair of finger rails and the garniture entrance cone are
25 adapted to receive between them a continuous strip of advancing paper web. In certain
26 circumstances, the advancing paper web has a predetermined pattern of additive material (e.g.,
27 bands) applied thereto. Each finger rail includes an air chamber, and the air chamber is adapted
28 to receive a high velocity stream of air. Each air chamber has a plurality of air distribution
29 outlets along its length directed generally downward toward the entrance cone. Those air
30 distribution outlets can be arranged in either a random or a predetermined pattern, preferably so
31 as to provide a turbulent flow of air below each finger rail. In the preferred embodiments, the

1 stream air and the design of the air outlet pattern provides for a relatively consistent air flow
2 from each of the various air distribution outlets. When the stream of air exits the air distribution
3 outlets, a zone of air movement (e.g., turbulence) is created above the advancing paper web; and
4 the action of that high velocity air flow acts to maintain the paper web a distance away from the
5 finger rails. Preferably, the entrance cone comprises an air chamber, and high velocity or
6 pressurized air is fed into that air chamber. Two air channels or slots, both providing air outlets,
7 or other suitably adapted air distribution means, are directed generally longitudinally, and are
8 designed so as to provide a flow of air generally upwardly and generally outwardly. When the
9 high velocity air exits the slots of the entrance, a zone of low pressure is created between the
10 paper web and the upper surface of the entrance cone. Each of the side edges of the paper web is
11 affected by this low pressure zone, and is urged toward the entrance cone upper surface and
12 away from the finger rails; and contact of the paper web with components of the finger rail
13 assembly is minimized, avoided or prevented. Thus, an improved method for the manufacture of
14 smoking articles, such as cigarettes, is provided.

15 In yet another aspect, the present invention relates to a system for controlling the heat to
16 which the web of wrapping material is subjected. That is, such a system can be used to control
17 the temperature (e.g., by heating or cooling) the web of paper wrapping material, and any
18 additive material that has been applied to that paper web. One suitable system is a radiant energy
19 system that utilizes electromagnetic radiation in the form of microwave radiation. In a highly
20 preferred embodiment, the moving continuous paper web is subjected to treatment using a
21 heating/cooling device (which most preferably is a radiant heating device) essentially
22 immediately after that paper web has additive material (e.g., a water-based coating formulation)
23 applied thereto.

24 The present invention, in one aspect, relates to a system for controlling, or registering, in
25 an on-line fashion, the location of the applied pattern (e.g., bands) of additive material on the
26 wrapping material to the location of that pattern on the smoking article that is manufactured. In
27 one embodiment, the application of each band is controlled relative to the speed at which the
28 cigarette making machine is operated; and the location of each band is timed to the operation of
29 the cutting device (e.g., flying knife) that cuts the continuous rod into cigarette rods of
30 predetermined length. In another embodiment, registration of patterns (e.g., bands) on a paper
31 web, and hence on predetermined locations on cigarettes, is provided using digital motion

1 control techniques that utilize a servo control system in combination with (i) digital encoders for
2 providing feedback of certain cigarette making machine operating parameters (e.g., such as
3 information regarding band positioning and continuous cigarette rod speed), and (ii) feedback
4 from a detector that responds to the presence of bands on the paper web.

5 In another aspect, the present invention relates an adapted automated cigarette making
6 apparatus of the type having a conveyor belt for tobacco filler supply, a garniture belt for
7 advancing a continuous strip of paper web, and a cutting knife for subdividing a continuous
8 cigarette rod into predetermined lengths; and all of the foregoing are operated using a single
9 power source (e.g., all of the foregoing are mechanically linked by belts and driven off of the
10 same main motor). The adapted apparatus is provided by disabling operation of the power
11 source, such as is accomplished by removing connection of operation of each of the conveyor
12 belt, the garniture belt and the cutting knife to that power source. Operation of the cutting knife
13 is adapted so as to be powered by a second power source (e.g., the motor of a servo system).
14 Operation of the garniture belt and the conveyor belt are provided by a third power source (e.g., a
15 motor of a servo system) that is independent of the second power source. As such, operation of
16 the garniture belt and conveyor belt are mechanically linked to one another. During operation of
17 the adapted apparatus, output signals from each of the second and third power sources are
18 provided to a control system; and the control system can provide independent feedback to each
19 of the second and third power sources so as to alter the speed of operation of those power sources
20 relative to one another (e.g., the second power source can be directed to speed up operation
21 and/or the third power source can be directed to slow down operation).

22 In yet another aspect, the present invention relates to a system for inspecting a substrate
23 in the form of a wrapping material for smoking article manufacture. The system is particularly
24 well suited for inspection of a web of paper wrapping material that has a discontinuous nature,
25 such as is provided by application of an additive material to all or a portion of that wrapping
26 material (e.g., as a pattern). The system possesses an emitter for directing radiation into contact
27 with the web of material containing a pattern such that the radiation impinges upon the web of
28 material and is absorbed. The system also possesses a detector (e.g., a near infrared sensor or
29 detector, or a non-contact ultrasonic transducer) for receiving reflected radiation from the web,
30 and for forming electrical signals representative of at least one selected component (e.g., water)
31 or representative change in mass of material corresponding to the presence of additive material.

1 The system further includes circuitry for processing the aforementioned electrical signals to
2 determine information relating to the presence of the pattern on the web, and for generating
3 output signals. The system further includes computing logic for receiving the output signals and
4 for determining whether those signals are representative of an unacceptable, irregular pattern on
5 the web or of an acceptable, desired pattern. The system further includes computer logic for
6 receiving information regarding irregular patterns and for signaling rejection of component
7 materials (e.g., formed cigarettes) manufactured from wrapping materials possessing additive
8 material that have been determined to possess irregular patterns.

9 In yet another embodiment, the present invention relates to system that can be used in an
10 "off-line" manner, and hence, for example, can provide a roll (e.g., a bobbin) of wrapping
11 material having additive material applied thereto. That is, the system can be used to apply a
12 desired pattern of additive material to a continuous strip of wrapping material using a first
13 system located at a first location, and the wrapping material so treated is used at a later time to
14 produce a smoking article using a second system (e.g., an automated cigarette making apparatus)
15 that is located at a second location. As such, the system is not necessarily integrally associated
16 with an automated cigarette making apparatus. Such an off-line system incorporates an
17 application system possessing additive applicator apparatus that is used to apply coating
18 formulation to a continuous substrate, such as a wrapping material for smoking article
19 manufacture. For example, a continuous strip of paper web is fed from a first bobbin, passed
20 through the additive applicator apparatus, and a pattern of additive material is applied to that
21 paper web as a coating formulation. The paper web optionally is passed by an appropriate
22 detection system that is capable of detecting the presence and amount of that formulation on
23 locations on that paper web. Then, the paper web most preferably is routed through a heat
24 control system (e.g., a radiant drying system, such as a microwave drying system) in order to dry
25 the formulation that has been applied to that paper web. Speed of travel of the paper web and
26 speed of operation of the additive applicator apparatus can be controlled, in order to ensure that
27 the formulation is applied in the appropriate manner, in the appropriate amount, and in the
28 appropriate locations on the paper web. Then, the paper web having dried additive material
29 applied thereto is wound onto a core or spool, thereby forming a second bobbin. That second
30 bobbin then can be removed from the system and stored. That second bobbin then can be used to
31 provide the continuous strip of paper web for the manufacture of a continuous smokable rod

1 using a conventional type of cigarette making machine. As such, there is provided a manner or
2 method for (i) providing a bobbin of a continuous strip of wrapping material of a composition
3 and physical configuration suitable for use for manufacture of a continuous cigarette rod using
4 automated cigarette making equipment, (ii) for applying additive material to that wrapping
5 material in an automated fashion such that a pattern of additive material is applied to that
6 wrapping material, (iii) for rewinding the wrapping material to provide a bobbin, and (iv) for
7 providing a bobbin of a continuous strip of wrapping material having additive material applied
8 thereto in a form and physical configuration suitable for use for manufacture of a continuous
9 cigarette rod using automated cigarette making equipment.

10 In yet another aspect, the present invention relates to certain formulations of additive
11 materials that can be applied to the wrapping material. In that regard, the present invention also
12 relates to wrapping materials having such formulations applied thereto (most preferably in a
13 controlled manner), and to cigarettes manufactured from those wrapping materials. Preferred
14 formulations of additive materials are water-based formulations that incorporate at least one
15 starch and/or at least one modified starch. Water soluble and/or water insoluble filler materials
16 (e.g., calcium carbonate and/or sodium chloride) also can be incorporated into those
17 formulations. Other ingredients, such as preservatives and/or colorants, also can be incorporated
18 into those formulations.

19 Features of the foregoing aspects and embodiments of the present invention can be
20 accomplished singularly, or in combination, in one or more of the foregoing. As will be
21 appreciated by those of ordinary skill in the art, the present invention has wide utility in a
22 number of applications as illustrated by the variety of features and advantages discussed below.
23 As will be realized by those of skill in the art, many different embodiments of the foregoing are
24 possible. Additional uses, objects, advantages, and novel features of the present invention are set
25 forth in the detailed description that follows and will become more apparent to those skilled in
26 the art upon examination of the following or by practice of the invention.

27 28 **BRIEF DESCRIPTION OF THE DRAWINGS**

29 Figure 1 is a schematic illustration of a portion of a cigarette making machine showing a
30 source of wrapping material, a source of tobacco filler and a garniture region that is used to
31 produce a continuous cigarette rod.

1 Figure 2 is a schematic illustration of a cigarette making machine assembly including the
2 combination of a wrapping material supply system and a cigarette making machine.

3 Figure 3 is a perspective of an additive applicator apparatus of one embodiment of the
4 present invention, that additive applicator apparatus being mounted at an appropriate location on
5 a cigarette making machine assembly.

6 Figure 4 is an exploded perspective of an additive applicator apparatus of the type shown
7 in Figure 3.

8 Figure 5 is a schematic illustration of an additive applicator apparatus of one embodiment
9 of the present invention.

10 Figure 6 is an exploded perspective of an additive applicator apparatus of the type shown
11 in Figure 5.

12 Figure 7 is a schematic illustration of an additive applicator apparatus of one embodiment
13 of the present invention.

14 Figure 8 is a schematic illustration of the outer side of the outer finger rail portion of a
15 finger rail assembly.

16 Figure 9 is a schematic illustration of the outer side of the inner finger rail portion of a
17 finger rail assembly.

18 Figure 10 is a schematic illustration of the outer side of the outer finger rail portion of a
19 finger rail assembly.

20 Figure 11 is a schematic illustration of the outer side of the inner finger rail portion of a
21 finger rail assembly.

22 Figure 12 is a perspective of a garniture entrance cone.

23 Figure 13 is an exploded perspective of a garniture entrance cone of the type shown in
24 Figure 12.

25 Figure 14 is an enlarged schematic cross-sectional view of a pair of finger rails and a
26 garniture entrance cone, as taken along lines 14 in Figure 1.

27 Figure 15 is a block diagram showing the components and general operation of a
28 registration system and an inspection system.

29 Figures 16-19 are schematic representations of various timing signals associated with
30 registration and inspection systems.

1 Figure 20 is a schematic illustration of a side view of an apparatus for making a smoking
2 article and wrapper, and specifically, a schematic illustration of a portion of a cigarette making
3 machine showing a source of wrapping material, an additive applicator apparatus, a source of
4 tobacco filler and a garniture region that is used to produce a continuous cigarette rod.

5 Figure 21 is a schematic illustration of an additive applicator apparatus of an embodiment
6 of the present invention.

7 Figure 22 is a schematic illustration of an additive applicator apparatus of an embodiment
8 of the present invention.

9 Figure 23 is a perspective of an additive applicator apparatus of one embodiment of the
10 present invention, that additive applicator apparatus being mounted at an appropriate location on
11 a cigarette making machine assembly.

12 Figures 24 - 28 are perspectives of a portion of an additive applicator apparatus of the
13 type shown in Figure 23.

14 Figure 29 is a schematic illustration of an apparatus for supplying and rewinding
15 wrapping material, and specifically, a schematic illustration of a source of wrapping material, an
16 additive applicator apparatus, a region for drying material applied to the wrapping material, and a
17 rewind unit for formatting the treated paper onto a bobbin.

18 Figure 30 is a perspective of an additive applicator apparatus of one embodiment of the
19 present invention, that additive applicator apparatus being configured so as to provide wrapping
20 material that can be supplied to a cigarette making machine assembly or wound onto a bobbin.

21 22 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

23 Aspects and embodiments of the present invention include cigarette making machines
24 and components thereof that are useful for manufacturing cigarettes, and in particular, that are
25 useful for transferring and retaining additive material on a paper wrapping web in an efficient,
26 effective and desired manner. Figures 1- 28 illustrate those aspects and embodiments. Like
27 components are given like numeric designations throughout the figures.

28 A conventional automated cigarette rod making machine useful in carrying out the
29 present invention is of the type commercially available from Molins PLC or Hauni-Werke
30 Korber & Co. KG. For example, cigarette rod making machines of the type known as Mk8
31 (commercially available from Molins PLC) or PROTOS (commercially available from Hauni-

1 Werke Korber & Co. KG) can be employed, and can be suitably modified in accordance with the
2 present invention. A description of a PROTOS cigarette making machine is provided in U.S.
3 Patent No. 4,474,190 to Brand, at col. 5, line 48 through col. 8, line 3, which is incorporated
4 herein by reference. Types of equipment suitable for the manufacture of cigarettes also are set
5 forth in U.S. Patent Nos. 4,844,100 to Holznagel; 5,156,169 to Holmes et al. and 5,191,906 to
6 Myracle, Jr. et al.; U.S. Patent Application 2003/0145866 to Hartman; U.S. Patent Application
7 2003/0145869 to Kitao et al.; U.S. Patent Application 2003/0150466 to Kitao et al.; and PCT
8 WO 02/19848. Designs of various components of cigarette making machines, and the various
9 material used to manufacture those components, will be readily apparent to those skilled in the
10 art of cigarette making machinery design and operation.

11 Referring to Figure 1, a one-component cigarette making machine assembly 8 includes
12 cigarette making machine 10. The cigarette making machine 10 includes a chimney region 16
13 that provides a source of tobacco filler 20, or other smoking material. The tobacco filler 20 is
14 provided continuously within an upwardly moving air stream (shown by arrow 22), and is blown
15 onto the lower outside surface of a continuous conveyor system 28. The conveyor system 28
16 includes an endless, porous, formable conveyor belt 32 that is supported and driven at each end
17 by left roller 36 and right roller 38. A low pressure region or suction chamber 41 within the
18 foraminous belt 32 acts to attract and retain tobacco filler 20 against the bottom of the conveyor
19 system 28. As such, tobacco filler 20 located below the conveyor belt 32 is pulled upward
20 toward that belt, thereby forming the tobacco filler into a tobacco stream or cake on the lower
21 surface of that belt. The conveyor belt 32 thus conveys the stream of tobacco filler 20 to the left;
22 toward a garniture section 45 of the cigarette making machine 10. An ecreteur or trimmer disc
23 assembly 48 assists in providing transfer of the appropriate amount of tobacco filler 20 to the
24 garniture region 45. Descriptions of the components and operation of several types of chimneys,
25 tobacco filler supply equipment and suction conveyor systems are set forth in U.S. Patent Nos.
26 3,288,147 to Molins et al.; 4,574,816 to Rudszinat; 4,736,754 to Heitmann et al. 4,878,506 to
27 Pinck et al.; 5,060,665 to Heitmann; 5,012,823 to Keritsis et al. and 6,630,751 to Fagg et al.; and
28 U.S. Patent Application 2003/0136419 to Muller.

29 Meanwhile, a continuous web of paper wrapping material 55 is supplied from a bobbin
30 58. The bobbin is supported and rotated using an unwind spindle assembly 59.

1 The paper web 55 is routed on a desired path using a series of idler rollers and guideposts
2 (shown as rollers 60, 61), through an optional printing assembly device 65, and ultimately
3 through the garniture region 45. Typically, product indicia are printed onto the paper web 55 at
4 predetermined regions thereof using printing assembly 65. Printing assemblies for printing
5 product indicia (e.g., logos in gold colored print) are component parts of commercially available
6 machines, and the selection and operation thereof will be readily apparent to those skilled in the
7 art of cigarette making machine design and operation. Techniques for registering the location of
8 printed product indicia on the ultimate cigarette product (e.g., on the paper wrapper of a cigarette
9 rod in a location immediately adjacent to the tipping material of that product) are known to those
10 skilled in the art of automated cigarette manufacture.

11 The paper web 55 also is routed through an applicator system 70 prior to the time that the
12 web reaches the garniture section 45. The applicator system 70 is employed to apply a desired
13 pattern of additive material 73 to the paper web 55. A representative pattern is provided by
14 applying spaced bands that are aligned transversely to the longitudinal axis of the paper web 55.
15 A representative additive material 73 is a coating formulation in a liquid, syrup or paste form.

16 Optionally, though not preferably, the paper web 55 can be routed through a
17 heating/cooling control unit (not shown) immediately before the paper web passes through the
18 applicator system 70. A suitable heating/cooling unit is a heating unit having the form of an
19 infrared heater (not shown), and that heater can be operated at any desired temperature; for
20 example, at a temperature of about 180°C to about 220°C. The heating/cooling unit can be used
21 to provide the paper web 55 at a desired temperature (e.g., the paper web can be pre-heated)
22 immediately prior to application of the additive material formulation 73 to the surface of that
23 paper web.

24 A representative additive applicator 70 comprises a pick-up roller 78 and a transfer roller
25 82. The pick-up roller 78 includes a plurality of patterned (e.g., evenly spaced apart) pockets on
26 its roll face (not shown) into which a predetermined amount of additive is deposited. The
27 positioning, shape and number of pockets can vary, and typically depends upon the pattern that is
28 desired to be applied to the paper web 55 (e.g., spaced apart pockets can be used to place spaced
29 bands of additive material 73 on the web). For example, in one embodiment of a transfer roller
30 82, seven pockets each having the form of transversely aligned bands each placed about 46 mm

1 apart. The shape, including depth, of each pocket can determine the amount of additive material
2 that can be carried by that pocket, and hence applied to the paper web 55.

3 The additive material 73 typically is provided from a supply source reservoir (not shown)
4 through tubing or other suitable supply means (not shown) to a port or supply region 85 near the
5 head (i.e., infeed region) of the pick-up roller 78. The additive material 73 is fed from the head
6 of the pick-up roller into the pockets of the pick-up roller.

7 If desired, the supply region and the region of the pick-up roller 78, and other relevant
8 regions of the additive applicator 70, can be supplied with heat control system using a suitable
9 heating or cooling device (not shown). As such, a heating device can provide a heated region
10 that can be used to assist in maintaining a solid or very viscous coating formulation in a melted
11 form, such as in the form of a liquid, syrup or paste. A representative heating device is an
12 electrical resistance heating unit controlled by a rheostat; and the heating device can be
13 appropriately fashioned so as to transfer the desired amount of heat to the various components of
14 the additive applicator 70. As such, sufficient heat can be provided to provide coating
15 formulation at a temperature above ambient temperature, and for example, at a temperature
16 within the range of about 120°F to about 180°F. If desired, heat insulation material (not shown)
17 can be positioned in adjacent regions of the cigarette making machine 10 in order that transfer of
18 heat to other regions of that machine is minimized or prevented.

19 Operation of the pick-up roller 78 and the transfer roller 82 are timed and controlled
20 relative to the speed of operation of the cigarette making machine 10. As the pick-up roller 78
21 and the transfer roller 82 are engaged in roll contact, and rotate in contact with each other on
22 their respective peripheral surfaces in a controlled manner, the additive material 73 is transferred
23 from the pockets of the pick-up roller 78 onto predetermined regions of the roll face surface (not
24 shown) of the transfer roller 82. The additive material 73 is transferred onto the transfer roller 82
25 surface in essentially the same pattern as that of the spaced apart pockets on the pick-up roller 78
26 (i.e., the pattern applied to the paper web is dictated by the design of the pattern of the roll face
27 of the pick-up roller 78).

28 The paper web 55 comprises two major surfaces, an inside surface 88 and an outside
29 surface 90. The stream of tobacco filler 20 ultimately is deposited upon the inside surface 88 of
30 the paper web 55, and the additive material 73 most preferably also is applied to the inside
31 surface 88 of that web. As the paper web 55 travels across the surface of the rotating transfer

1 roller 82, the additive material 73 on the surface of the transfer roller 82 is transferred to the
2 inside surface 88 of the advancing paper web 55 at locations corresponding to the location of the
3 pockets located on the roll face of the pick-up roller 78.

4 After the additive material 73 has been applied to the paper web 55, the web can be
5 exposed to a sensor or detector 95 for a measurement system, such as a registration system
6 and/or an inspection system (not shown). Preferably, the detector 95 is mounted on the frame of
7 the cigarette making machine 10 and is positioned so as to receive information concerning the
8 paper web 55 immediately after additive material 73 has been applied to that paper web.

9 Typically, the detector 95 is a component of certain registration systems and inspection systems
10 of the present invention. Suitable detector systems are described hereinafter in greater detail
11 with reference to Figure 15. Alternative sensors, detectors and inspection system components
12 and description of inspection system technologies and methods of operation are set forth in U.S.
13 Patent Nos. 4,845,374 to White et al.; 5,966,218 to Bokelman et al.; 6,020,969 to Struckhoff et
14 al. and 6,198,537 to Bokelman et al. and U.S. Patent Application 2003/0145869 to Kitao et al.;
15 U.S. Patent Application 2003/0150466 to Kitao et al.; which are incorporated herein by
16 reference.

17 A representative inspection system employs a capacitance detector positioned
18 downstream from the applicator system 70. A preferred detector is a non-contact detector that
19 can sense changes in the dielectric field of the paper web resulting from the application of
20 additive material to certain regions of that paper web. A representative detector is a Hauni Loose
21 End Detector, Part Number 2942925CD001500000 that is available from Hauni-Werke Korber
22 & Co. KG. The detector is combined with appropriate electronics for signal processing. That is,
23 the detector generates an electrical signal, and appropriate electronic circuitry is used to compare
24 that signal relative to a programmed threshold level. Such a signal allows for graphical display
25 of the profile of applied additive material along the length of the paper web. When application
26 of a band of additive material does not occur as desired (i.e., a band is missing on the paper web,
27 or the amount of additive material that is applied is not the desired amount) a signal is generated.
28 As such, rejection of poor quality rods, and adjustments to the overall operation of the cigarette
29 making machine, can occur. In addition, an output signal from such a measurement system can
30 be used in a feedback control system to maintain the desired level of additive material to the

1 paper web and/or to maintain the desired rate of feed of coating formulation to the applicator
2 system.

3 Additionally, after the additive material 73 has been applied to the paper web 55, the web
4 can be passed through an optional heating/cooling control device 120. The control device 120
5 can be used to alter the heat to which the paper web 55 and additive material 73 is subjected
6 (e.g., by raising or lowering temperature). For example, the heating/cooling control device can
7 be a heating or drying device adapted to assist in the removal of solvent (e.g., moisture) from the
8 additive material 73 that has been applied to the paper web 55. Alternatively, for example, the
9 heating/cooling control device can be a cooling device adapted to assist in the hardening melted
10 additive material 73 that has been applied to the paper web 55 using a heated additive applicator
11 system 70. Typically, the heating/cooling control device 120 has a tunnel-type configuration
12 through which the paper web 55 is passed; and during the time that the paper web is present
13 within that tunnel region, the paper web is subjected to heating supplied by a convection or
14 radiant heating device, or cooling supplied by a refrigerant-type, solid carbon dioxide-type or
15 liquid nitrogen-type cooling device.

16 Typically, the region of the cigarette making machine 10 where the heating/cooling
17 device 120 is located does not afford sufficient room to provide a heating/cooling control device
18 120 of any appreciable size. For this reason, it is desirable to locate such an optional
19 heating/cooling device 120 in a location that is offset from the cigarette making machine. For
20 example, appropriately located and positioned turning bars (not shown) can be used to direct the
21 paper web 55 outward (and optionally upward or downward) from the front face of the cigarette
22 making machine 10, and the paper web 55 can be routed through the heating/cooling device 120
23 that can be supported but frame or other suitable support means (not shown), and appropriately
24 located and positioned turning bars (not shown) can be used to direct the paper web 55 so
25 subjected to heating or cooling back to the cigarette making machine 10 for continued use in the
26 cigarette manufacturing process.

27 Optionally, though not preferably, the indicia printing assembly 65 can be modified in
28 order to print formulations other than printing inks and intended for purposes other than product
29 indicia. For example, the printing assembly 65 can be adapted to apply coating formulations
30 having intended purposes other than product indicia. For example, fluid coating formulations
31 (e.g., that incorporate pre-polymer components and are essentially absent of solvent, or that are

1 water-based), can be applied to either the inside surface or outside surface of the paper web 55,
2 using a suitably adapted printing assembly 65. Such coating formulations can be supplied using
3 a pump or other suitable means (not shown) from a reservoir (not shown) through a tube or other
4 suitable supply means (not shown). The paper web 55 having water-based additive material (not
5 shown) applied thereto is subjected to exposure to heat or microwave radiation using heat source
6 126, in order to dry the coating formulation and fix additive material to the desired location on
7 the paper web. A reflective shield or cover (not shown) can be positioned over that radiation
8 source 126. The previously described heating/cooling control device 120 and/or the radiation
9 source 122 also can be employed.

10 The paper web 55 travels toward the garniture region 45 of the cigarette making machine
11 10. The garniture region 45 includes an endless formable garniture conveyor belt 130. That
12 garniture conveyor belt 130 conveys the paper web 55 around a roller 132, underneath a finger
13 rail assembly 140, and advances that paper web over and through a garniture entrance cone 144.
14 The entrance cone 144 also extends beyond (e.g., downstream from) the finger rail assembly
15 140. The right end of the garniture conveyor belt 130 is positioned adjacent to and beneath the
16 left end of the suction conveyor system 28, in order that the stream of tobacco filler 20 carried by
17 conveyor belt 32 is deposited on the paper web 55 in that region. The finger rail assembly 140
18 and garniture entrance cone 144 combine to provide a way to guide movement of an advancing
19 tobacco filler cake 20 from the suction conveyor 32 to the garniture region 45. Selection and use
20 of finger rail assemblies and garniture entrance cones will be readily apparent to those skilled in
21 the art of cigarette manufacture. Alternatively, finger rail assemblies and/or garniture entrance
22 cones that are described in greater detail hereinafter with reference to Figures 8-14 can be
23 employed.

24 As the conveyor belt 32 and tobacco filler cake 20 travel within the finger rail assembly
25 140, vacuum suction applied to the inside region of the conveyor belt 32 is released. As a result,
26 tobacco filler 20 is released from contact with the conveyor belt 32, falls downwardly from that
27 conveyor belt through a longitudinally extending track (not shown) within the finger rail
28 assembly 140, and is deposited onto the advancing paper web 55 at the left side of the garniture
29 region 45 immediately below the finger rail assembly. In conjunction with the release of vacuum
30 from the conveyor belt 32, removal of tobacco filler 20 from the conveyor belt 32 and deposit of
31 that tobacco filler onto the moving paper web 55 is facilitated through the use of a shoe or scrape

1 155 or other suitable means, that is used to peel or otherwise physically remove advancing
2 tobacco filler 20 off of the outer surface of the extreme left end of the conveyor belt 32.

3 The garniture section 45 includes a tongue 160 adjacent to the distal end of the finger rail
4 assembly 140 and above the top surface of the garniture conveyor belt 130. The tongue 160
5 provides a commencement of constriction of the tobacco filler 20 that has been deposited on the
6 paper web 55. Meanwhile, the garniture conveyor belt 130 begins to form that tobacco filler
7 stream and paper web 55 into a continuous rod 170. The tongue 160 extends to a point where the
8 paper web 55 is secured around that stream of tobacco filler. The tongue 160 and the garniture
9 conveyor belt 130 define a passage which progressively decreases in cross-section in the
10 direction of movement of the tobacco filler stream, such that the deposited tobacco filler stream
11 progressively forms a substantially circular cross-section that is desired for the ultimate finished
12 continuous cigarette rod 170.

13 The garniture section 45 also includes a folding mechanism 180 on each side of the
14 garniture conveyor belt 130 located adjacent to, and downstream from, the tongue 160. The
15 folding mechanism 180 is aligned in the direction of filler stream movement, further compresses
16 the tobacco filler 20 within the rod that is being formed, and folds the paper web 55 around the
17 advancing components of the forming continuous cigarette rod 170. A fashioned continuous
18 tobacco rod that exits the tongue 160 and folding mechanism 180 then passes through an
19 adhesive applicator 184, in order that adhesive is applied to the exposed length or lap seam
20 region of the paper web 55. That is, the exposed length of paper web 55 then is lapped onto
21 itself, and the adhesive is set that region in order to secure the paper web around the tobacco
22 filler 20, thereby forming the continuous cigarette rod 170. The continuous rod 170 passes
23 through a cutting or subdivision mechanism 186 and this subdivided into a plurality of rods 190,
24 191 each of the desired length. The selection and operation of suitable subdivision mechanisms
25 186, and the components thereof, will be readily apparent to those skilled in the art of cigarette
26 manufacture. For example, the cutting speed of knife (not shown) within a ledger or other
27 suitable guide 192 is controlled to correspond to the speed that the cigarette making machine 10
28 is operated. That is, the location that an angled flying knife (not shown) cuts the continuous rod
29 170 into a plurality of rods 190, 191, each of essentially equal length, is controlled by controlling
30 the speed of operation of that knife relative to speed that the cigarette making machine supplies
31 the continuous rod.

1 Typically, operation of the conveyor belt 32, garniture belt 130 and flying knife (not
2 shown) within ledger 192 all are mechanically linked to one another by belts or other suitable
3 means, and are driven off of the same power source (not shown). For example, for a cigarette
4 making machine, such as a PROTOS 80 that is commercially available from Hauni-Werke
5 Korber & Co. KG, the main motor of that cigarette making machine is used to drive operation of
6 the conveyor belt 32, the garniture belt 130 and the flying knife. An alternate design of such a
7 type of cigarette making machine can be provided by providing power to the flying knife from
8 one power source, such as the motor of a servo system (not shown); and the power to the
9 garniture belt 130 and the conveyor belt 32 can be provided from a second power source, such as
10 the motor of a second servo system (not shown). Typically, power for operation of the garniture
11 belt 130 is provided by suitable mechanical connection to the second power source, and the
12 power for operation of the conveyor belt 32 is provided by suitable linkage to the operation of
13 the garniture belt by suitably adapted timing belt systems, or other suitable means (not shown).
14 Encoders (not shown) mechanically coupled to the first and second servo systems (not shown)
15 provide information to a processing unit (not shown) regarding cigarette manufacturing speed,
16 and garniture speed, respectively. The detector 95 (e.g., such as a non contact ultrasonic
17 detector) also can be adapted to provide information regarding location of additive material 73
18 that has been applied to the paper web 55 to the same processing unit (not shown). Using the
19 processing unit, the positioning of applied pattern on the paper web 55 can be compared to a
20 specified positioning of the pattern, and the processing unit can be used to alter the speed of
21 operation of the two servo systems relative to one another to bring cigarette rods 190, 191 that
22 are out of specification back to within specification. For example, the speed of operation of the
23 flying knife can be increased and/or the speed of operation of the garniture belt can be decreased
24 until cigarette rods are determined to be back within the desired range of tolerance or within
25 specification.

26 Servo control systems and the operation thereof will be readily apparent to those skilled
27 in the art of cigarette making machine design and operation. Representative servo systems are
28 readily available as Single Axis Controller P/N: DKC03.3-040-7FW/FWA-EDODR3-FGP-
29 04VRS-MS, Motor P/N: MKD025-144-KP1-KN SERVO MOTOR from Indramat, available
30 through Bosch Rexroth; Ultra 5000 Single Axis P/N: 2098-IPD-010 Motor P/N: Y-2012-1-

1 H00AA from Allen Bradly; and Servo P/N :SC752A-001-01 Motor P/N: R34-GENA-HS-NG-
2 NV-00 from Pacific Scientific.

3 Information concerning the position and speed of operation of the flying knife can be fed
4 to a servo control system that incorporates a multi-axes programming unit. Such a servo system
5 is available as PPC-R02-2N-N-N1-V2-NN-FW from Indramat through Bosch Rexroth. As such,
6 the servo system can be used to observe and control the transfer roller to a known position
7 relative to the flying knife. Preferred cigarette making machines, such as PROTOS machines,
8 can possess an automatic servo-driven print displacement control systems as well as servo-driven
9 paper tension control systems. Thus, the distance of travel of the paper web between the
10 applicator system and the continuous cigarette rod cutoff knife can be changed; for example,
11 when adjustments are made to correct for print displacement relative to the cut in the continuous
12 rod or to control paper tension to avoid paper breakage. Such changes in distance of travel of the
13 paper web can vary; and for example, the changes of as much as 35 mm in paper travel can be
14 provided for adjustments for print displacement, and changes of as much as 20 mm in paper
15 travel can be provided for paper tension adjustments. Thus, when any adjustments are made that
16 result in a change in the length of the path of travel of the paper web from the applicator roller to
17 the flying knife, the multi-axes control system can be used to make the corresponding
18 adjustments to the speed of operation of the applicator roller. Most preferably, adjustments to
19 the speed of operation of the applicator roller are provided at times when the applicator roller is
20 not in the process of applying additive material to the paper web. As such, adjustments
21 programmed to occur between the application of successive bands result in avoiding smearing of
22 additive material on the paper web and in avoiding paper breakage. To minimize the number of
23 reject cigarettes, adjustments can be made on a single rod resulting in only a single rejected rod,
24 or adjustments can be made as small changes spread out over a number of cigarette rods until the
25 application system is adjusted to be back to providing cigarettes having patterns applied at the
26 desired locations.

27 Those cigarette rods 190, 191 then most preferably have filter elements (not shown)
28 attached thereto, using known components, techniques and equipment (not shown). For
29 example, the cigarette making machine 10 can be suitably coupled to filter tipping machine (not
30 shown), such as a machine available as a MAX, MAX S or MAX 80 Hauni-Werke Korber & Co.

1 KG. See, also, for example, U.S. Patent Nos. 3,308,600 to Erdmann et al. and 4,280,187 to
2 Reuland et al.

3 The cigarette making machine assembly and configuration described with reference to
4 Figure 1 are representative of a single cigarette making machine that provides both the tobacco
5 filler and the patterned paper web to the garniture region of that machine. Cigarette making
6 machine assemblies and configurations representative of those that provide the tobacco filler to
7 the garniture region from one location, and the patterned paper web to the garniture region from
8 another location, (i.e., multi-component systems), are described with reference to Figure 2.

9 Referring to Figure 2, there is shown a two-component automated cigarette making
10 machine assembly 8 that is constructed by coupling a wrapping material supply machine 200
11 (e.g., a first component) with a cigarette making machine 10 (e.g., a second component).

12 A suitable wrapping material supply machine 200 can be provided by appropriately
13 modifying a web supply unit available as SE 80 from Hauni-Werke Korber & Co. KG. See, for
14 example, U.S. Patent No. 5,156,169 to Holmes et al., which is incorporated herein by reference.
15 Other suitable unwind units, such those having the types of components set forth in U.S. Patent
16 No. 5,966,218 to Bokelman et al., also can be employed. The supply machine 200 most
17 preferably is a free-standing machine that is capable of providing a patterned web of wrapping
18 material 55 to a conventional (or suitably modified) cigarette making machine 10. The supply
19 machine 200 includes a frame 205 that supports at least one unwind spindle assembly 220 onto
20 which a first bobbin 224 is mounted. Preferably, the supply machine 200 includes a second
21 unwind spindle assembly 228 for a second bobbin (not shown), and a web splicing mechanism
22 232.

23 The paper web 55 is threaded through a tension sensor 236, which, in conjunction with a
24 braking component 239 is connected to the shaft of the unwind spindle assembly, maintains a
25 desired amount of tension on the paper web 55 as it is transferred from the bobbin 224.

26 In operation, a continuous paper web 55 supplied from a bobbin 58 is routed through a
27 path defined by a series of idler rollers 245, 247 and guideposts 255, 256. The paper web 55 also
28 is routed through an applicator system 70 that is used to apply a desired pattern of additive
29 material 73 to the paper web 55. A representative additive material 73 is a coating formulation
30 in a liquid, syrup or paste form. Optionally, though not preferred, the paper web can be routed

1 through a heating/cooling control unit (not shown) immediately before the paper web passes
2 through the applicator system 70.

3 A representative additive applicator 70 comprises a pick-up roller 78 and a transfer roller
4 82, and can be operated in essentially the same manner as described previously with reference to
5 Figure 1. The additive material 73 typically is provided from a supply source reservoir (not
6 shown) through tubing (e.g., Tygon-type or polyethylene tubing) or other suitable supply means
7 (not shown) to a port or supply region 85 near the head (i.e., infeed region) of the pick-up roller
8 78. If desired the supply region and the region of the pick-up roller can be supplied with heat
9 using a suitable heating device (not shown). The additive material 73 is fed from the head of the
10 pick-up roller into the pockets of the pick-up roller. As the pick-up roller 78 and the transfer
11 roller 82 are engaged in roll contact, and rotate in contact with each other, the additive material
12 73 is transferred from the pockets of the pick-up roller 78 onto predetermined regions of the roll
13 face surface (not shown) of the transfer roller 82. The additive material 73 is transferred onto the
14 transfer roller 82 surface in essentially the same pattern as that of the spaced apart pockets on the
15 pick-up roller 78 (i.e., the pattern on the paper web is defined by that pattern on the roll face of
16 the pick-up roller). The additive material 73 most preferably also is applied to predetermined
17 locations on the inside surface 88 of the paper web 55.

18 After the additive material 73 has been applied to the paper web 55, the web can be
19 exposed to a sensor or detector 95 for a registration system and/or an inspection system (not
20 shown). Preferably, the detector 95 is positioned so as to receive information concerning the
21 paper web 55 immediately after additive material 73 has been applied to that paper web.
22 Typically, the detector 95 is used in conjunction with the certain registration systems and
23 inspection systems of the present invention. Suitable detector systems are described hereinafter
24 in greater detail with reference to Figure 15. Alternative sensors, detectors and inspection
25 system components and description of inspection system technologies and operation are set forth
26 in U.S. Patent Nos. 4,845,374 to White et al.; 5,966,218 to Bokelman et al.; 6,020,969 to
27 Struckhoff et al. and 6,198,537 to Bokelman et al.; which are incorporated herein by reference.

28 Additionally, after the additive material 73 has been applied to the paper web 55 (i.e.,
29 downstream from the applicator apparatus 70), the web can be passed through an optional,
30 though highly preferred, heating/cooling control device 280, or other suitable means for
31 controlling heat to which the paper web is subjected. The control device 280 can be used to alter

1 the heat to which the paper web 55 and additive material is subjected (e.g., by raising or lowering
2 the temperature). For example, the control device can be a heating or drying device adapted to
3 assist in the removal of solvent (e.g., moisture) from the additive material 73 that has been
4 applied to the paper web 55. Alternatively, for example, the heating/cooling control device can
5 be a cooling device adapted to assist in the hardening melted additive material 73 that has been
6 applied to the paper web 55 using a heated additive applicator system 70. Typically, the
7 heating/cooling control device 280 has a tunnel-type configuration through which the paper web
8 55 is passed (through an inlet end 282 and out an outlet end 283); and during the time that the
9 paper web is present within that tunnel region, the paper web is subjected to heating supplied
10 using infrared convection or radiant heating devices, or cooling supplied using refrigerant-type,
11 solid carbon dioxide-type or liquid nitrogen-type cooling devices.

12 The size of the heating/cooling device 280 can vary, particularly because that device is
13 positioned and supported by a component 200 that is physically separated from, and spaced
14 from, the cigarette making machine 10. That is, there is provided sufficient room to subject the
15 paper web 55 to treatment using the heating/cooling device 280. Exemplary heating/cooling
16 devices 280 have lengths of about 2 feet to about 10 feet, with lengths of about 3 feet to about 8
17 feet being typical, and lengths of about 4 feet to about 7 feet being desirable. The distance that
18 the paper web 55 travels through the heating/cooling device 280 (i.e., the length of travel through
19 that device) can vary. For example, the paper web 55 can be routed back and forth within the
20 heating/cooling device 280 using a suitably adapted roller system configuration (not shown).

21 Most preferably, the heating/cooling control device 280 is used to provide radiant heating
22 to the paper web 55. An exemplary heating and drying system 280 is available as IMS Model
23 No. P24N002KA02 2kW, 2450 MHz Linear Drying System from Industrial Microwave Systems,
24 Inc. Representative types of radiant drying systems are set forth in U.S. Patent Nos. 5,958,275 to
25 Joines et al.; 5,998,774 to Joines et al.; 6,075,232 to Joines et al.; 6,087,642 to Joines et al.;
26 6,246,037 to Drozd et al. and 6,259,077 to Drozd et al.; all of which are incorporated herein by
27 reference. Such types of radiant drying systems can be manufactured from materials such
28 aluminum and aluminum alloys. See, also, U.S. Patent No. 5,563,644 to Isganitis et al., which is
29 incorporated herein by reference.

30 Radiant-type drying systems are preferred, because typical infrared-type drying systems
31 require relatively long residence times to adequately remove effective quantities of solvent or

1 liquid carrier (e.g., water) from the paper web 55. For fast moving paper webs 55 running at
2 nominal cigarette making machine speeds, the application of sufficient heat demands the need
3 for relatively long infrared-type drying apparatus. Additionally, sufficient heat from infrared-
4 type drying systems requires the use of relatively high temperatures; thus providing the
5 propensity for scorching and browning of certain areas of the paper web, and the risk of fire. For
6 example, for a conventional cigarette making machine operating so as to produce about 8,000
7 cigarette rods per minute, and having bands of additive material applied to the advancing paper
8 web so that about 1 mg of water is applied to each individual cigarette rod, about 350 to about
9 700 watts per hour is effectively required to remove that water from the paper web.

10 A microwave-type drying system is desirable because effectively high amounts of heat
11 can be employed in controlled manners. An exemplary system is one that employs planar wave
12 guide of about 36 inches in length, an internal width of about 1.6 inches, and an internal depth of
13 about 3.7 inches. Preferred wave guides are of dimension to allow passage of only lowest order
14 (i.e., TE₁₀) or single mode radiation. An exemplary system also can possess inlet and outlet ends
15 282, 283 that both have widths of about 1.75 inch and heights of about 0.37 inch. Within the
16 inner region of the drying system, immediately within each end of the inlet and outlet ends 282,
17 283, are positioned choke flanges, pin chokes (not shown) or other means to assist in the
18 prevention of escape or leakage of radiation from the system; and those flanges or pins typically
19 extent about 3 inches into the system from each respective end.

20 Microwave-type drying systems can apply heat to desirable locations on the paper web
21 55 where heat is needed (i.e., in the printed regions of the paper web). In one preferred radiant-
22 type drying system, microwave energy is launched at one end of a waveguide and is reflected at
23 the other end of that waveguide, resulting in the paper web experiencing radiant energy for
24 effectively an extended period. Precise drying control can be achieved by attenuating the
25 microwave energy and/or the path of the paper web within the microwave drying system. Such
26 radiant-type drying systems thus can be used to evaporate the solvent or liquid carrier (e.g.,
27 water) of the additive material formulations by applying the microwave energy uniformly
28 throughout the patterned region (e.g., to the bands of applied additive material coating
29 formulation).

30 The controls for the radiant-type dryer (e.g., the microwave control and associated safety
31 systems) most preferably are integrated into the programmable logic controller-based (PLC-

based) control system (not shown) for supervisory control. The PLC-based system (not shown) enables radiant energy production, and disables the radiant energy production when radiant energy is not needed for drying (e.g., such as when the production system is stopped or paper web experiences a break). The top and bottom regions of the wave guide of the drying system in portions of the drying region can be perforated with a plurality of perforations (not shown) to allow for the removal of moisture, without allowing radiation (e.g., microwave radiation) from escaping into the surroundings. A suitably designed shroud 287 and an electrically driven fan (not shown) can be placed over the top of those perforations in order to remove the evaporated moisture away from the paper web and remove dust from the system. If desired, the fan (not shown) also can be under the control of the PLC-based system, and as such, only operate during operation of the cigarette manufacturing system 8.

For a radiant heating system 280 for the embodiment shown in Figure 2, radiant microwave energy is supplied by a generator 290 for electromagnetic radiation, which is located one end of that system. Typically, higher power generators are used to produce heat to remove greater amounts of moisture; and generators producing up to about 10 kW of power, and usually up to about 6 kW of power, are suitable for most applications. Radiation produced by the generator is passed through appropriate wave guides and circulators (not shown). The microwave radiation passes through a curved wave guide 292 and through a drying region 294 for the paper web 55. A typical drying region for a microwave drying system has a length of about 30 inches. As such, the radiation supplied to the drying system and the paper web 55 move in the same overall direction through that drying system. Radiation that travels through the drying region 294 is reflected by suitable reflector 296 (i.e., a short plate or reflector plate) at the other end of the drying system. That radiation is reflected back through the drying region, back through the channel at the other end of the heating system, and as such, the reflected radiation and the paper web 55 move in an overall counter current manner relative to one another. Any remaining radiation is appropriately redirected through appropriately positioned wave guides and circulators to a dry air-cooled load 298, or other suitable radiation dissipation means. As such, the radiation is converted to heat, and the resulting heat can be removed using electrical fans (not shown) or other suitable means.

In a preferred embodiment (not shown), the positioning of the heating device 280 shown in Figure 2 is reversed (e.g., the heating device is rotated 180°) such that the paper web 55 enters

1 at the end of the heating device possessing the reflector 296 and exits at the end through which
2 radiation enters the channel 292 from the generator 290. As such, radiation entering the drying
3 system from the source of radiation and the paper web 55 travel in an overall counter current
4 manner relative to one another.

5 The additive applicator 70 used in conjunction with the supply machine 200 most
6 preferably is driven by a servo drive control system (not shown) or other suitable control means.
7 Suitable servo-based systems and the operation thereof are described in greater detail hereinafter
8 with reference to Figure 15. As such, the positioning of the additive material on the paper web
9 55 can be controlled relative to the location that the continuous cigarette rod 170 that is
10 manufactured using the second component 10 is cut into predetermined lengths, and hence,
11 registration of the applied pattern of additive material on a finished cigarette can be achieved.
12 That is, the automated cutting knife (not shown) for subdividing the continuous rod into
13 predetermined lengths can be controlled relative to those components used to apply additive
14 material to the paper web that is used to provide that continuous rod.

15 The paper web 55 exits the temperature control device 280 and is advanced to the
16 cigarette making machine 10. Direction of the paper web 55 is provided by suitably aligned
17 series of idler rollers 312, 314, 316 (or guideposts, turning bars, or other suitable means for
18 directing the paper web from the first component 200 to the second component 10). Suitable
19 pathways for travel of the paper web 55 can be provided by suitably designed tracks or tunnels
20 (not shown). As such, there is provided a way to direct the paper web from the first component
21 200 to the second component 10.

22 The continuous paper web 55 is received from the first component 200 by the second
23 component 10. Typically, the paper web 55 is directed from idler roller 316 to roller 60 of the
24 cigarette making machine 10, or other suitable location. The paper web 55 travels through
25 printing assembly 65 where indicia can be printed on the outer surface 90 of that web, if desired.
26 The paper web 55 then travels to the garniture region 45 of the cigarette making machine 10,
27 where there are provided components for manufacturing a continuous cigarette rod 170 by
28 wrapping the tobacco filler 20 in the paper web. The garniture conveyor belt 130 advances that
29 paper web through that garniture region. At the left end of the suction conveyor system 28,
30 tobacco filler 20 is deposited from its source on the foraminous belt 32 onto the paper web 55.
31 The garniture region 45 includes finger rail assembly 140, garniture entrance cone 144, scrape

1 155, tongue 160, folding mechanism 180 and adhesive applicator 184, that are employed to
2 provide a continuous cigarette rod 170. The continuous rod 170 is subdivided into a plurality of
3 rods (not shown), each of the desired length, using known techniques and equipment (not
4 shown). Those rods then most preferably have filter elements attached thereto, using known
5 techniques and equipment (not shown).

6 The cigarette making machine assembly and configuration described with reference to
7 Figure 2 are representative of cigarette making machine assemblies and configurations that can
8 be used to provide tobacco filler 20 to a garniture region 45 from one location, and the patterned
9 paper web 55 to the garniture region from another location. Furthermore, the representative
10 cigarette making machine assembly (i.e., with the component that provides the patterned paper
11 web positioned to the front and to the right of the component that incorporates the tobacco source
12 and the garniture assembly) is such that the general direction of travel of the paper web through
13 the wrapping material supply machine is essentially parallel to the direction of travel of the paper
14 web through the garniture region of the cigarette making machine. However, the positioning of
15 the wrapping material supply machine to the cigarette making machine can vary. For example,
16 the wrapping material supply machine 200 can be positioned beside or behind the cigarette
17 making machine; or positioned generally perpendicular to the garniture region of the cigarette
18 making machine 10. In such circumstances, the path of travel of the paper web from the
19 wrapping material supply machine to the cigarette making machine can be accomplished through
20 the use of appropriately positioned idler bars and roller guides. The exact path of travel of the
21 paper web is a matter of design choice, and the selection thereof will be readily apparent to those
22 skilled in the art of design and operation of cigarette manufacturing equipment.

23 Referring to Figure 3, there is shown a portion of a cigarette making machine assembly 8
24 of the present invention. In particular, there is shown an additive applicator apparatus 70
25 representative of one aspect of the present invention. Such an additive applicator 70 is
26 particularly useful for applying to a paper web 55 additive materials that are not particularly
27 viscous (e.g., formulations of additive materials having viscosities of less than about 1,000
28 centipoise).

29 Additive applicator 70 is an assembly that includes a pick-up roller 78 and a transfer
30 roller 82 mounted adjacent to each other and through a first or front roller support plate 400 on
31 the exterior front face of the cigarette making machine assembly 8. A second or rear roller

1 support plate 408, located in the plane of and adjacent to the front roller plate 400, provides a
2 surface to which other structures of the additive applicator 70 are mounted. Components of the
3 additive applicator apparatus 70, including rollers 78, 82 and support plates 400, 408 are
4 manufactured from materials such as stainless steel or hardened carbon steel. Several fixed or
5 rotatable guide rollers 420, 422, 424, 426, 428 are suitably fixedly mounted; such as to either the
6 front roller plate 408 or rear roller plate 410, depending upon the desired location of those guide
7 rollers. Those guide rollers provide the path over which the paper web 55 travels from a bobbin
8 (not shown), past the additive applicator 70, and on to other downstream destinations of the
9 cigarette making machine assembly.

10 The additive applicator 70 also includes a manifold 444 positioned above an additive
11 material reservoir 448, which is defined by the positioning of a reservoir front arm 452 and a
12 reservoir rear arm 454. Those arms 452, 454 are positioned above the pick-up roller 78. Tubing
13 458, or other suitable supply means, is connected to the manifold 444 and originates at a source
14 of additive material (not shown) to provide an input of additive material to reservoir 448, and
15 hence to the roll face of the pick-up roller 78. That portion of the additive applicator assembly
16 thus provides a sealed path for flow of additive material to the region where that additive
17 material is deposited onto the pick-up roller. Preferably, the reservoir front arm 452 and rear arm
18 454 each include at least one port (not shown), located on the bottom sides of each of those arms
19 452, 454. At least one of those ports is an output port through which additive material is
20 supplied to the roll face of the pick-up roller 78. At least one other port is an input port through
21 which a suction pump (not shown) suctions excess additive material from the edges of the pick-
22 up roller 78, and pumps excess additive material back into the reservoir 448 defined by arms
23 452, 454. The assembly also includes a collection pot 465 positioned adjacent to and slightly
24 below the pick-up roller 78. The collection pot 465 serves as a temporary collection location for
25 excess additive material removed from the pick-up roller 78.

26 The manifold 444 is attached to a glue manifold pivot plate 470, which is attached to the
27 front roller plate 400 and the rear roller plate 408. Such attachment leaves the manifold 444 with
28 the capability of moving upward and downward about a manifold pivot pin (not shown).
29 Movement of the manifold 444 upward from the operative position allows access to those
30 regions located below the manifold. Access to that region is desirable have access to the
31 reservoir arms 452, 454, to insert, remove and service the pick-up roller 78, and for maintenance

1 and service of the collection pot 465. In addition, the reservoir arms 452, 454, are movable
2 upward and downward about a reservoir pivot shaft (not shown) to allow access to the pick-up
3 roller 78 and the collection pot 465.

4 The transfer roller 82 and the pick-up roller 78 are positioned into operative engagement
5 with one another using a roller pressure plate 480. The roller pressure plate 480 is operably
6 connected to an air cylinder 484, or other suitable means for applying force to rollers 78, 82.
7 The air cylinder 484 utilizes compressed air to force the roller pressure plate 480 about a
8 pressure plate pivot shaft 488 into and out of engagement with the transfer roller 82. Movement
9 of the roller pressure plate 480 to engage and disengage the pick-up roller 78 with the transfer
10 roller 82 can be programmed, and as such a microprocessor associated with the operation of the
11 cigarette making machine can be used to control movement of that plate 480.

12 The additive applicator 70 further comprises a roller lift bracket 495 mounted to the front
13 roller plate 400, and that lift bracket is movable. The roller lift bracket 495 includes a pair of
14 rollers 500, 505, or other suitable means for controlling the path of travel of the paper web 55.
15 The roller lift bracket 495 is operably connected to an air cylinder 510, or other suitable means
16 for applying force to the lift bracket. The air cylinder 510 also is connected to a supply of
17 pressurized air by an air tube 512, or other suitable connection and supply means. The air
18 cylinder 510 utilizes compressed air to move the pair of rollers 500, 505 on the roller lift bracket
19 495 into and out of rotating contact with the advancing paper web 55. For example, when the
20 rollers 500, 505 on the roller lift bracket 495 move downward into contact with the paper web
21 55, that paper web is likewise moved into rotating contact with roll face of the transfer roller 82.
22 As a result of the contact of the paper web 55 with the transfer roller 82, the additive material
23 applied to the transfer roller is transferred to the inside surface of the paper web, in a desired
24 pattern or fashion. Movement of the roller lift bracket 495 and rollers 500, 505 into and out of
25 contact with the paper web 55 can be programmed, and as such a microprocessor associated with
26 the operation of the cigarette making machine can be used to control movement of that bracket
27 495. The roller lift bracket 495 can be controlled by a signal received from the cigarette making
28 machine, in order that the bracket can be retracted and the paper web 55 can be moved so as to
29 not be in contact with the various rollers when the cigarette making machine is not in normal
30 operation; and as such, problems associated with sticking of the paper web to various
31 components of the applicator apparatus 70 are minimized, avoided or prevented.

1 In operation, during the process of cigarette manufacture, the pick-up roller 78 is rotated
2 counter-clockwise, and the transfer roller 82 is rotated clock-wise. Those rollers are engaged in
3 contact by pressure supplied by the pressure plate 480. Additive material is fed from a source
4 (not shown) to the manifold 444, and from the manifold to the reservoir 448, from the reservoir
5 to the roll face of the pick-up roller 78, and onto the transfer roller 82. The additive material
6 then is transferred from the transfer roller to the paper web 55 as the paper web advances across
7 the surface of the rotating transfer roller 82. That is, as the paper web 55 advances across the
8 surface of the rotating transfer roller 82, the roller lift bracket 495 is moved downward, and the
9 rollers 500, 505 attached to that roller lift bracket are moved into contact with the advancing
10 paper web 55. As a result, the additive material on the surface of the transfer roller 82 is
11 transferred to the inside surface of the advancing paper web 55 at locations corresponding to the
12 pattern on the roller face of the transfer roller 82. The paper web 55 having additive material
13 applied thereto then is advanced to downstream locations of the cigarette making machine.

14 Referring to Figure 4, there is shown a portion of an additive applicator apparatus 70
15 representative of one aspect of the present invention. The pick-up roller 78 and the transfer
16 roller 82 are shown roll contact with one another and in operative engagement. Pick-up roller
17 possesses a roll face having a pattern of recessed grooves, or pockets, 535, 537, 539, 541, 543,
18 having the form of spaced bands, or other desired pattern. Those recessed grooves provide a
19 location for a predetermined amount of additive material to be deposited, and the size and shape
20 of those grooves is a matter of design choice. The pick-up roller 78 is rotated using a pick-up
21 drive shaft 550 (shown as cut away); and the transfer roller 82 is rotated using an applicator drive
22 shaft 554 (shown as extending from opening 556 in the applicator drive shaft box 558. The drive
23 shafts 550, 554 extend through an opening 560 in the front roller support plate 400, which is
24 adjacent the rear roller support plate 408. The pick-up roller 78 and the transfer roller 82 are
25 adapted to extend beyond the front faces of each of the front and rear roller plates 400, 408.

26 The applicator drive shaft box 558 is adapted to be positioned and secured to the back
27 side of the front and rear roller plates 400, 408. A pick-up roller gear 580 is in operative
28 connection with the pick-up drive shaft 550. A transfer roller gear 584 is in operative connection
29 with the applicator drive shaft 554. Both gears 580, 584 are located external to the applicator
30 drive shaft box 558, and are positioned on the back side of that drive shaft box 558. Those gears
31 580, 584 have interlocking teeth such that rotation of one of those gears in one direction causes

1 rotation of the other gear in the opposite direction. The transfer roller gear 584 is connected to a
2 transfer roller pulley 590. A belt 595 extends about the transfer roller pulley 590 and around a
3 power source pulley (not shown). As a result, power for rotational movement is provided to the
4 transfer roller shaft 550 and transfer roller 82 by rotation of the pulley 590 by movement of the
5 belt 595; and power for controlled rotational movement is provided to the pick-up roller 78 by
6 way of the drive shaft 550 that is rotated by operation of gears 580, 584. In addition, belt 595
7 can act as a timing belt, and by suitable use of that belt to control the speed of the applicator
8 drive shaft 554 relative to the speed of operation of the cigarette making machine, it is possible
9 to provide integral timing with the cigarette rod subdivision mechanism (not shown) of the
10 cigarette making machine. Thus, appropriate use of belt 595 to connect appropriate gear
11 mechanisms yields a method for providing pattern (e.g., band) registration for each individual
12 finished cigarette rods (not shown) that are cut from the continuous rod (not shown).

13 The applicator assembly 70 of the present invention can further include a photoelectric
14 sensor switch (not shown) located above a point of roller engagement between the pick-up roller
15 78 and the transfer roller 82. An exemplary sensor is a WT 12-2P430 from Sick, Inc. Output
16 from the photoelectric proximity switch is sent to a PLC or other suitable processor (not shown)
17 associated with that photoelectric sensor (not shown) and monitors the amount (e.g., level) of
18 additive material (not shown) in the region above that point of roller engagement of rollers 78,
19 82. Thus, as a flow of additive material is supplied from the manifold 44 and reservoir 448, an
20 amount of the additive material forms at the point of engagement between those rollers 78, 82.
21 When the amount of that additive material supplied to that region drops below a predetermined
22 level for sufficient desired transfer of the additive material to the transfer roller 82, the
23 information sensed and supplied by photoelectric sensor controls a switch to activate a pump (not
24 shown), and hence to supply more additive material to the reservoir 448. Similarly, deactivation
25 of the pump can be controlled when a desired level of additive material is achieved.

26 The applicator assembly 70 can further include sensors (not shown) that assist in ensuring
27 that proper amounts of additive material is transferred to the paper web. For example, an
28 induction-type sensor (not shown) located in the region of a pick-up roller 78 can sense that the
29 pick-up roller, and other associated components of the applicator assembly, are in proper
30 position. In addition, the cigarette making machine can be programmed such that when the
31 induction sensor detects that the pick-up roller is not in proper position, that machine can provide

1 appropriate signal to the operator or cease operation. In addition, a further sensor (not shown)
2 can be mounted on the rear roller plate 408 at a location of the paper web after that paper web
3 has passed over the transfer roller 82. That further sensor can be used to detect the presence, or
4 degree of presence, of additive material on the paper web 55. Detection of a sufficient presence
5 of additive material on the paper web 55 indicates that additive material transfer mechanisms are
6 operating properly. The cigarette making machine can be programmed to alert the machine
7 operator or stop movement of the paper web 55 if the further sensor detects an insufficient
8 presence of the additive material on the paper web 55.

9 Referring to Figure 5, there is shown a portion of a cigarette making machine assembly 8
10 of the present invention; and there also are shown relevant components of another representative
11 embodiment of an additive applicator apparatus 70 of the present invention. Such an applicator
12 70 is particularly useful for applying to a paper web 55 more viscous additive materials, than
13 those embodiments described previously with reference to Figures 3 and 4. More viscous
14 additive materials useful in applications involving cigarette paper include, for example,
15 formulations of additive materials having viscosities of greater than 100,000 centipoise. Such
16 higher viscosity additive materials can be characterized as pastes.

17 Additive applicator 70 is an assembly that includes a major pick-up/transfer roller 720
18 and a transfer pressure roller 725 (or back-up roller) mounted adjacent to each other and through
19 a front roller plate 730 secured to front exterior of a cigarette making machine. Each of a
20 plurality of rollers 422, 426, 428 is fixedly mounted to the front roller plate 730; and those rollers
21 provide guides for a path over which the paper web 55 travels from a bobbin (not shown) to the
22 additive applicator 70 and on to other regions of the cigarette making machine 8.

23 Positioned adjacent to the major roller 720 is a reservoir 740 for the additive material.
24 The reservoir is maintained in place and secured to the front roller plate 730 by bolts (not shown)
25 or other suitable connection means. The reservoir 740 is connected to a source (not shown) of
26 additive material (e.g., a formulation having the form of a paste), through port 742 near the top
27 region of the reservoir 740. As such, a source of additive material for the major roller 720 is
28 provided. Typically, the additive material is supplied through tubing (not shown), such as
29 Tygon-type tubing, that feeds the reservoir 740 through port 742. The additive applicator 70
30 provides a sealed path for flow of the additive material to the point of deposit onto the major
31 roller 720. The reservoir 740 includes at least two ports (not shown) on the side thereof adjacent

1 to the major roller 720. One port is an output port positioned near the middle of the reservoir
2 740, through which additive material is supplied to the major roller 720. At least one other port
3 is an input port through which excess additive material is scraped from the edges of the major
4 roller 720, and is fed back into the reservoir 740.

5 The reservoir 740 is attached to an assembly that is designed to exert pressure upon that
6 reservoir. Such a pressure exerting assembly includes a reservoir pad 748 that is positioned
7 adjacent to the reservoir 740. The reservoir pad 748 is held in position by a reservoir pad
8 retainer 753, which encompasses the reservoir pad 748. Compression springs 756, 758 are
9 positioned between the reservoir pad retainer 753 and a reservoir spring retainer 761, and
10 provide resistance for tightening of the reservoir spring retainer 761 toward the reservoir 740.
11 Screws 765, 767, or other suitable connection means, are positioned through each side of the
12 reservoir spring retainer 761, through the center of each respective compression spring 756, 758,
13 and through a passage in each side of the reservoir pad retainer 753. The screws 765, 767 are
14 movable in and out of respective passages 770, 772 of the reservoir pad retainer 753. The
15 threaded ends of the screws 765, 767 are positioned in threaded contact with threaded walls of
16 the passages 770, 772 of the reservoir pad 748 so as to supply the application of pressure to the
17 reservoir pad 748 when pressure is exerted against the reservoir spring retainer 761.

18 An adjustment screw mounting plate 778 is attached to the front roller plate 730 adjacent
19 to the reservoir spring retainer 761. An adjustment screw 781 is threaded through the adjustment
20 screw mounting plate 778 into contact with the reservoir spring retainer 761. When the
21 adjustment screw 781 is adjusted a predetermined amount inward into increasingly compressive
22 contact with reservoir spring retainer 761, pressure is applied by the screws 765, 767 to the
23 reservoir pad 748. As a result, a predetermined amount of pressure is exerted on the paste
24 reservoir 740. The additive material formulation is caused to flow to the reservoir 740 by
25 application of head pressure supplied from an upstream pumping system (not shown) or other
26 suitable means. The additive applicator 70 also can be equipped with sensors and control
27 devices (not shown) of the type described previously with reference to Figure 4.

28 A scraper plate 783 is connected to the reservoir 740. A compression spring 785 is
29 positioned between a scraper 783 and the scraper plate 787 such that the scraper is urged into
30 operative contact with the roll face of the major roller 720. As such, excess additive material on
31 the surface of the roll face of the major roller 720 is scraped from that roll face as the moving

1 major roller passes the scraper, and that material is deposited back into the reservoir 740. Thus,
2 additive material carried by the major roller 720 for transfer to the paper web is located in the
3 desired location; within the pockets located on the roll face of that roller.

4 Rollers 790, 792, 794 together with transfer pressure roller 725 are positioned on a roller
5 lift bracket 798. The roller lift bracket 798 is designed to be moved downward by the forces
6 applied by air cylinder 805 about a lift bracket pivot plate 806. The air cylinder 805 is connected
7 to a source of pressurized air (not shown), and is employed to provide for movement of the roller
8 lift bracket 798. The roller lift bracket 798 is attached on one end to the front roller plate 730
9 about lift bracket pivot plate 806 through roller lift bracket pivot pin 807, and the lift bracket 798
10 is movable. The roller lift bracket 798 further includes a lift bracket pivot sleeve 808, which is
11 slidably attached on the end opposite the pivot pin 807 to lift bracket pivot plate 806.

12 In operation, the transfer pressure roller 725 and rollers 790, 792, 794 can be moved
13 about the pivot pin 807 so as to be positioned into and out of contact with the upper surface of
14 the paper web 55. When the transfer pressure roller 725 is moved into operative contact with the
15 major roller 720, the transfer pressure roller 725 rotates under the power of the major roller 720,
16 but in the opposite direction to that of the major roller. Preferably, the major roller 720 rotates
17 clockwise, and the transfer pressure roller 725 rotates counter-clockwise. The transfer pressure
18 roller 725 thus preferably contacts the advancing paper web 55 at a point of engagement of the
19 roll faces of the transfer pressure roller 725 and the major roller 720. As a result of the pressured
20 contact experienced by the paper web 55 as it travels between transfer pressure roller 725 and the
21 major roller 720, additive material is applied to the paper web 55 in a predetermined pattern.
22 Movement of the roller lift bracket 798, transfer pressure roller 725, and rollers 790, 792, 794
23 into and out of contact with the paper web 55 can be programmed, and as such a microprocessor
24 associated with the operation of the cigarette making machine can be used to control movement
25 of that lift bracket 798. The roller lift bracket 798 can be controlled by a signal received from
26 the cigarette making machine, in order that the bracket can be retracted and the paper web 55 can
27 be moved so as to not be in contact with the various rollers when the cigarette making machine is
28 not in normal operation; and as such, problems associated with sticking of the paper web to
29 various components of the applicator apparatus 70 are minimized, avoided or prevented.

30 Referring to Figure 6, there are shown relevant components of a portion of an additive
31 applicator apparatus 70 representative of one aspect of the present invention. The major roller

1 720 possesses a roll face having a pattern of recessed grooves or pockets 820, 822; thus
2 providing a pocketed wheel. The diameter of the major roller can vary, but suitable major roller
3 has a diameter of about 104 mm. Exemplary grooves provide spaced bands located so as to
4 extend perpendicularly to the longitudinal axis of a paper web and across a portion of the width
5 of that paper web, and are generally box-like in shape. The dimensions of the grooves can vary,
6 and are dependent upon factors such as the pattern of application that is desired; but suitable
7 grooves have depths of about 2 mils, longitudinally extending lengths of about 5 mm, and
8 transversely extending lengths of about 23 mm. Those grooves 820, 822 are designed to contain
9 additive material (not shown) and to transfer that additive material to a paper web (not shown)
10 that contacts that roller face as the paper web travels past the roll face of the major roller 720.
11 As such, for the pattern shown, spaced apart bands are applied at predetermined intervals
12 transversely to the longitudinal axis of the continuous paper web. That is, the recessed grooves
13 820, 822 provide a location for a predetermined amount of additive material to be deposited on a
14 paper web; and the size and shape of those grooves is a matter of design choice. The major roller
15 720 is manufactured from materials such as stainless steel, hardened carbon steel, or the like.

16 The roller lift bracket 798 supports rollers 790, 792, 794 and back-up roller 725. Back-up
17 roller 725, or "soft-faced" roller, typically is manufactured from stainless steel or hardened
18 carbon steel, and the roll surface is provided by an overlying band or ring of a suitable material
19 such as a rubber-type or elastomeric material. Suitable "soft-faced" rollers 725 are adapted from
20 those types of commonly used for component parts of conventional cigarette making machines,
21 and are manufactured from materials commonly used in conventional cigarette making
22 machines. The roller lift bracket also supports the air cylinder 805 and the pivot plate 806. The
23 diameter of the back-up roller 798 can vary, but a suitable back-up roller has a diameter of about
24 40 mm.

25 The reservoir 740 for the additive material is assembled along with the reservoir spring
26 retainer 761, the adjustment screw mounting plate 778, the adjustment screw 781, scraper 783
27 and the scraper plate 787.

28 Positioned on the front roller plate 730 are a plurality of rollers 422, 426, 428 and an
29 opening 824. The major roller 720 is connected to a roller drive shaft 828 that passes through
30 opening 824 and to an applicator drive shaft box 830 that is in turn connected to a roller gear
31 834. A belt 595 extends about the roller gear 834 and around a pulley 838 mounted to a power

1 drive assembly 841. Rotational power is provided from the power drive assembly 841 to the
2 roller gear 834 to the roller shaft 828 and to the major roller 720. Timing belt pulley 842 can be
3 used to receive input regarding the speed of operation of the cigarette making machine, and
4 hence can be use in conjunction with a belt (not shown) to time operation of the other
5 components of the applicator apparatus 70.

6 Referring to Figure 7, there are shown relevant components of a portion of yet another
7 additive applicator apparatus 70 representative of one aspect of the present invention. Other
8 components of the additive applicator apparatus, and the general operation thereof, are described
9 previously with reference to Figures 5 and 6. Such an applicator 70 is particularly useful for
10 applying to a paper web 55 more viscous additive materials. More viscous additive materials
11 useful in applications involving cigarette paper include, for example, paste-type formulations of
12 additive materials having viscosities of greater than 100,000 centipoise.

13 Additive applicator 70 is an assembly including a major pick-up/transfer roller 850 that is
14 generally similar to that pocketed roller described previously with reference to Figures 5 and 6.
15 For example, the diameter of the major roller 850 can be about 104 mm, and the major roller can
16 be manufactured from materials such as stainless steel, hardened carbon steel, and the like.
17 Several rollers (not shown) are fixedly mounted to the front roller plate 730; and those rollers
18 provide guides for a path over which the paper web 55 travels from a bobbin (not shown) to the
19 additive applicator 70, between the roll faces of major roller 850 and back-up roller 725, and on
20 to other regions of the cigarette making machine 8.

21 Positioned adjacent to the major roller 850 is a reservoir 855 for the additive material.
22 The reservoir is maintained in place and secured to the front roller plate 730 by bolts (not shown)
23 or other suitable connection means. The reservoir 855 is connected to a source (not shown) of
24 additive material (e.g., a formulation having the form of a paste), through the top region of the
25 reservoir 855. As such, a source of additive material for the major roller 850 is provided. A
26 portion of the reservoir 855 is shown in phantom in order to show more clearly the positioning of
27 a portion of the major roller 850 within the reservoir, and to more clearly show the positioning of
28 the scrapers 860, 864 against the roll face and side, respectively, of the major roller. Typically,
29 the additive material is supplied through tubing (not shown), such as Tygon-type tubing, that
30 feeds the reservoir 850 through a port (not shown). The additive applicator 70 provides a path
31 for flow of the additive material to the point of deposit onto the major roller 850.

1 A scraper 860 is connected to the body of the reservoir 855. The scraper 860 is urged
2 into operative contact with the roll face of the major roller 850. As such, excess additive
3 material on the surface of the roll face of the major roller 850 is scraped from that roll face as the
4 moving major roller passes the scraper, and that material is deposited back into the reservoir 855.
5 Thus, additive material carried by the major roller 850 for transfer to the paper web is located in
6 the desired location; within the pockets located on the roll face of that roller. Against the front
7 side face of major roller 850 is positioned a scraper 864. A corresponding scraper (not shown) is
8 positioned against the back side face of the major roller 850. As such, the roll face and both side
9 faces are subjected to surface treatment by three scraper pieces arranged in a "U"-like
10 configuration, so as to remove undesirable excess additive formulation from those surfaces, and
11 hence, maintain those surfaces relatively clean by maintaining those surfaces relatively free of
12 build up of coating formulation.

13 Referring to Figure 8, there is shown one finger rail 925 of a finger rail assembly
14 representative of one aspect of the present invention. That finger rail 925 is referred to as the
15 "outside" finger rail, and an exemplary finger rail has a length of about 22 cm. Exemplary finger
16 rails and finger rail assemblies that can be modified in accordance with one aspect of the present
17 invention are commercially available, and the design and use of finger rails and finger rail
18 assemblies in cigarette making machines will be readily apparent to those skilled in the art of
19 cigarette making machine design and operation.

20 Finger rail 925 includes a downwardly extending outside finger rail protrusion or
21 projecting arm 928 that gradually narrows to form a blade-like lower face 929. At its garniture
22 end 931, the bottom portion of the finger rail 925 curves gradually upward and with a gradually
23 increasing angle towards the extreme garniture end 931. The finger rail 925 is adapted to include
24 an air chamber or manifold 934, or other means for distributing and defining passage of air flow
25 within the finger rail. A typical manifold 934 has a length of about 15 cm, a width of about 5
26 mm, and a depth of about 4 mm. Such a manifold 934 can be provided by drilling out, or
27 otherwise fashioning, that region of a conventional finger rail that is manufactured from a
28 material such as stainless steel, hardened carbon steel, or other suitable metal alloys. Preferably,
29 as shown, the manifold is aligned so as to extend lengthwise in a generally parallel manner
30 relative to the axis that defines the length of the finger rail. The finger rail 925 also includes an
31 air passageway 947 extending through the finger rail and into the manifold 934, near the

1 garniture end 931 of that finger rail; and as such an air passageway extends entirely through the
2 finger rail. The air passageway 937 provides a path for the flow of air into the manifold 934 that
3 is supplied from a source of pressurized air (not shown) through a tube or other suitable
4 connection means (not shown) from the back side of the finger rail 925 (i.e., the air passageway
5 937 provides a means for introducing air flow to the air distribution means).

6 Extending generally downward from the manifold 934 and along the outside face of the
7 finger rail 925 are several narrow air channels 940, 941, 942. Those air channels, grooves or
8 passageways are formed, drilled, cut, etched or otherwise fashioned in the lower region of the
9 finger rail 925 along the length of the manifold. Thus, the air flow passageways 940, 941, 942
10 are in air flow communication with the manifold, and those air flow passageways provide for
11 exit of high velocity air flow from the finger rail. The number of air channels can vary, and can
12 be a manner of design choice. However, the number of air flow passageways typically can range
13 from about 15 to about 30, with about 18 to about 28 being preferred. Typically, the air flow
14 passageways are spaced about 6 mm apart, and the width of each air flow passageway is about
15 20 mils. The plurality of air channels 940, 941, 942 can be positioned in a random or
16 predetermined pattern, and the air channels all can point in the same direction (e.g., generally
17 downward) or air channels can multi-directional in nature (e.g., the air channels can point
18 generally downward, downward and inwardly, downward and outwardly, and the like).

19 The finger rail 925 further includes a manifold cover (not shown), that covers the outer
20 side of the finger rail in order that air flow from the air passageway 937 passes through the
21 manifold 934 and out the plurality of air channels 940, 941, 942 directed out from the bottom of
22 the finger rail. The manifold cover typically has the form of a metal plate that is secured in place
23 to the finger rail 925 over the manifold 934 using epoxy-type cement, spot weld, or other suitable
24 means. Covering the manifold 934 ensures the desired passage of high velocity air out of the air
25 passageways 940, 941, 942.

26 Referring to Figure 9, there is shown one finger rail 950 of a finger rail assembly
27 representative of one aspect of the present invention. That finger rail 950 is referred to as the
28 "inside" finger rail, and is designed to form a finger rail assembly when used in conjunction with
29 the "outside" finger rail previously described with reference to Figure 8. The overall design and
30 appearance of the inside finger rail 950 is generally similar in many regards to that of the

1 previously described outside finger rail. However, the corresponding finger rails are designed to
2 have a somewhat "mirror image" or a "left handedness/right handedness" relative to one another.

3 At its garniture end 952, the bottom portion of the finger rail 950 curves gradually
4 upward. The finger rail 950 also is adapted to include an air chamber 954 or manifold. The
5 finger rail 950 also includes an air passageway 956 extending through the finger rail and into the
6 manifold 954, near the garniture end 952 of that finger rail. Extending downward from the
7 manifold 954 along the outside face of the finger rail 950 are several narrow air channels 960,
8 961, 962. Those air channels are formed, drilled, cut, etched or otherwise fashioned in the lower
9 region of the finger rail 925 along the length of the manifold. Most preferably, those air channels
10 960, 961, 962 are positioned in a staggered, pattern along the lower region of the manifold 954.
11 The finger rail 950 further includes a manifold cover (not shown).

12 Referring to Figure 10, there is shown one finger rail 980 of a finger rail assembly
13 representative of another aspect of the present invention. That finger rail 980 is referred to as the
14 "outside" finger rail. Exemplary finger rails and finger rail assemblies that can be modified in
15 accordance with this aspect of the present invention also are commercially available, and the
16 design and use of finger rails and finger rail assemblies in cigarette making machines will be
17 readily apparent to those skilled in the art of cigarette making machine design and operation.

18 The overall design and appearance of finger rail 980 is generally similar in many regards
19 to that of the outside finger rail previously described with reference to Figure 8. The finger rail
20 980 is adapted to include a generally longitudinally-extending relief channel 982 cut or otherwise
21 fashioned along the lower outer face of the finger rail. The finger rail 980 includes a tube 985
22 for air passage, and preferably, the tube has a generally circular cross sectional shape. The tube
23 985 extends along the relief channel 982, and as such, the tube is aligned so as to extend
24 lengthwise in a generally parallel manner relative to the axis that defines the length of the finger
25 rail. The tube 985 is secured to the finger rail 980 using epoxy-type cement, spot weld, or other
26 suitable attachment means. The tube 985 provides a path for the flow of air that is supplied to
27 the other end of that tube from a source of pressurized air (not shown) through a tube or other
28 suitable connection means (not shown) from a region relatively remote from the finger rail 980.
29 That is, it is preferable that one end 986 of the tube 985 is open to receive a source of high
30 velocity air, and the other end 987 of tube 985 is sealed or closed to as to prevent the exit of air

1 flow therefrom. The inner diameter of tube 985 can vary, but typically such a tube can have an
2 inner diameter of about 2 mm to about 5 mm.

3 The tube 985 includes a plurality of air distribution outlets 988, 989, 990 that extend
4 along its length, and in its lower region; such that air passing through the tube flows out of those
5 outlets and is directed generally downward. As such, the tube 985 is in functional alignment
6 with the finger rail. A typical tube 985 possesses air distribution outlets extending about 15 cm
7 along its length. The air distribution outlets 988, 989, 990 are a series of small openings or
8 narrow passageways arranged, and those passageways can be positioned in a predetermined,
9 random or staggered pattern. By "staggered" is meant that the various air channels are arranged
10 in a non-linear fashion, the distances between individual air channels are not necessarily all the
11 same, or the various air channels direct air in different directions. One representative pattern of
12 air channels is composed of two longitudinally-extending rows that are offset from one another
13 (e.g. in a zig zag type pattern), and the openings of the inside row are designed to direct air flow
14 generally straight downward, and the openings of the outside row are designed to direct air flow
15 downward and outward.

16 The dimensions of the air passageways 988, 989, 990 can vary, but suitable air
17 passageways are small openings. The cross sectional shape of those openings can vary, but
18 suitable openings of generally circular cross sectional shape often are about 20 mils in diameter.
19 Normally, the number of those narrow air channels extending downward from the tube 985
20 ranges from about 15 to about 30, with about 18 to about 28 being preferred.

21 Referring to Figure 11, there is shown one finger rail 995 of a finger rail assembly
22 representative of one aspect of the present invention. That finger rail 995 is referred to as the
23 "inside" finger rail, and is designed to form a finger rail assembly when used in conjunction with
24 the "outside" finger rail previously described with reference to Figure 10. The overall design
25 and appearance of the inside finger rail 995 is generally similar in many regards to that of the
26 outside finger rail previously described with reference to Figure 10. The finger rail 995 also is
27 adapted to include tube 998 for air passage. Extending downward from the tube 998 are several
28 narrow air channels 1005, 1006, 1007, preferably in a staggered arrangement. Those air
29 channels are located in the lower region of the finger rail 995 along a portion of the length of the
30 tube 998.

1 The finger rails that are described with reference to Figures 8 through 11 are properly
2 assembled into finger rail assemblies on cigarette making machines. In operation, those finger
3 rail assemblies are provided with a supply of pressurized air that enters the relevant air
4 passageways and chambers of the finger rails. That moving air then passes out of the numerous
5 air distribution outlets that direct the flow of air generally downward. The relative dimensions
6 (e.g., the inside diameters) of the various air distribution outlets depend upon factors such as the
7 desired rate of air flow and related fluid dynamics. For most applications, an air flow rate is
8 determined by experimentation, and the amount of airflow employed to provide the desired or
9 optimum operation is a matter of design choice. In a preferred embodiment, the supply of
10 pressurized air provides a continuous flow of air sufficient to reach each air distribution outlet
11 along the length of an air supply tube or manifold, such that a substantially equal rate of air flow
12 from each air distribution outlet is achieved. A consistent air flow rate from each finger rail air
13 distribution outlet in a staggered pattern has the tendency to promote formation of the desired
14 turbulent air flow pattern below the finger rail assembly.

15 Referring to Figure 12, there is shown an embodiment of another aspect of the present
16 invention. A modified garniture entrance cone 144 is designed to be positioned within a
17 cigarette making machine in a region below the finger rail assembly (not shown). Exemplary
18 entrance cones that can be modified in accordance with one aspect of the present invention are
19 commercially available, and the design and use of entrance cones in cigarette making machines
20 will be readily apparent to those skilled in the art of cigarette making machine design and
21 operation. An exemplary garniture entrance cone has a length of about 23 cm, a width of about 5
22 cm and a maximum height of about 2 cm. Typically, the entrance cone is manufactured from
23 materials such as stainless steel, hardened carbon steel, aluminum alloys, and the like. Modified
24 entrance cones can be of multi-piece construction, such as is shown in Figure 12, or one-piece
25 construction.

26 Garniture entrance cone 144 includes a downstream section 1020, an upstream section
27 1022, and a modified upper insert 1024 for a portion of the upper region of the upstream section.
28 The entrance cone 144 possesses a generally concave upper surface 1030. Within that upper
29 surface 1030 are opposing longitudinally-extending lower lateral aspects 1035, 1037, and within
30 the upstream section 1022 are corresponding opposing upper lateral aspects 1040, 1042. Each of

1 the lower lateral aspects and each of the upper lateral aspects are positioned on opposite sides of
2 a longitudinally-extending concave upper surface 1030.

3 An entrance cone 144 of the type of the present invention also includes a first
4 longitudinal-extending air flow passage slot or gap 1050 located between lower lateral aspect
5 1035 and upper lateral aspect 1040; and a second longitudinally-extending front air flow passage
6 slot or gap 1052 located between the lower lateral aspect 1037 and upper lateral aspect 1042.
7 Preferably, the overall shapes of the two slots on each side upper portion of the upstream section
8 1022 of the entrance cone are such that those slots are mirror images of one another. Typically,
9 the width of each slot ranges from about 0.5 mil to about 3 mils, with about 1 mil to about 2 mils
10 being preferred. The entrance cone 144 includes an air entrance chamber 1060 on the bottom
11 side of the entrance cone, or in any other suitable location. An exemplary air entrance chamber
12 or port 1060 is a tube-like member that provides a generally circular air entrance opening of
13 about 9 mm in diameter. A source of air for a fast moving air stream is provided from a suitable
14 source, such as a laboratory-type pressurized or compressed air source (not shown), and the air
15 entrance chamber 1060 is suitably connected to the supply of pressurized air by a suitable
16 connection means, such as Tygon-type tubing or the like. The air flow introduced through the air
17 entrance chamber 1060 preferably passes through a manifold or passageway system (not shown)
18 located within the entrance cone, and passes out of the longitudinally extending air slots 1050,
19 1052. For an exemplary entrance cone, those air slots 1050, 1052 preferably are positioned so as
20 to extend length-wise about 14.5 cm. As such, the air slots 1050, 1052 extend along the entrance
21 cone 144 that distance that the finger rail assembly (not shown) overlies the finger rail when
22 configured under normal assembly within a cigarette making machine; however, the air slots can
23 extend a lesser distance or a greater distance. Those slots also each can be positioned at angles
24 that extend upward and outward. Typically, the angles are at least about 45° relative to
25 horizontal at the extreme upstream end of the entrance cone 144; and the angles gradually
26 becomes steeper along the length of the extreme cone, such that the angles are at least about 75°
27 at the extreme downstream ends of those slots. As such, that air flow is directed from slot 1050
28 toward the upper lateral aspect 1040, and from slot 1052 upwards and outwards toward the upper
29 lateral aspect 1042.

30 Referring to Figure 13, the representative garniture entrance cone 144 includes
31 downstream section 1020 that is longitudinally aligned with upstream section 1022. Those

1 sections are maintained in place relative to one another using male pegs (not shown) that are
2 inserted into cooperating female grooves 1054, 1056. Preferably, for an entrance cone of about
3 23 mm total length, the upstream section has a length of about 14.5 mm. Typically, the length of
4 the upper insert 1024 and the entire length of the upstream section 1022 are essentially equal to
5 one another. Normally, the lengths of the upstream section 1022 and the upper insert 1024, and
6 the positioning of each of those sections, correspond to that region of the entrance cone 144 that
7 is located immediately below the overlying portion of the finger rail assembly (not shown), when
8 those components are properly assembled within a cigarette making machine (not shown). The
9 upper insert 1024 is designed to provide the designed concave surface structure to a portion of
10 the upper surface of the garniture entrance cone 144. Beneath the upper insert 1024 is provided a
11 cavity 1058 that provides a type of manifold for air flow that is introduced through air inlet 1060.
12 For a representative upstream section 1022 having a length of about 14.5 cm, a suitable manifold
13 1058 has a length of about 14.5 cm, a depth of about 0.5 mm to about 1 mm, and a width of
14 about 7 mm to about 15 mm. Thus, air entering the manifold 1058 passes out of the slots or
15 grooves (not shown) that are located between (i) the bottom and sides of the upper insert 1024,
16 and (ii) the top and sides of the upstream section 1022. The upper insert 1024 and the upstream
17 section 1022 are maintained in place relative to one another using appropriately located pegs and
18 grooves, and suitable adhesives materials (e.g., epoxy-type cement).

19 Referring to Figure 14, there is shown a region of a cigarette making machine 10,
20 representative of that of the types of cigarette making machines described previously with
21 reference to Figures 1 and 2. In particular, there is shown the entrance region of the garniture
22 section 45 of a cigarette making machine 10. There is shown a cross-sectional end view of a
23 finger rail assembly 140 that is representative of one aspect of the present invention and an
24 entrance cone 144 that has been adapted in accordance with another aspect of the present
25 invention. Additionally, there is shown tobacco filler 20 held by foraminous belt 32 that is
26 supported by roller 132 (shown as partially cut away). There also is shown garniture conveyor
27 belt 130 and paper web 55 having additive material 73 applied to one surface of that paper web.

28 The finger rail assembly 140 includes two complementary finger rails; that is front finger
29 rail 925 and back finger rail 950. The finger rails 925, 950 are of the type described previously
30 with reference to Figures 8 and 9, respectively. That is, each finger rail possesses a plurality of
31 spaced, downwardly extending air passageways from manifolds 934, 954, respectively. For the

1 cross-sectional view shown, the positioning of the air passageways is staggered; thus, the region
2 of the back finger rail 950 that is shown possesses a downwardly extending air passageway 960,
3 while the region of the front finger rail 935 shown is not a region where a downwardly extending
4 air passageway has been positioned. Manifold covers 1110, 1112 cover a portion of the outside
5 faces of finger rails 925, 959, respectively. Those manifold covers 1110, 1112 are secured in
6 place by suitable means, such as spot welds or epoxy-type cement.

7 The finger rails 925, 950 both are positioned in their normal essentially parallel, spaced
8 apart alignment above entrance cone 144, such that the downwardly projecting arms defined by
9 the shape of those finger rails form opposing sides of a substantially rectangular, longitudinally
10 extending passageway, channel or track 1120. The foraminous belt 32 and the tobacco filler
11 cake 20 supported and transported by that belt travel through the upper region of that track 1120.

12 A portion of the garniture entrance cone 144 includes a downwardly concave, or
13 semicircular, upper surface face 1030. As such, the passageway 1120 is defined by an upper
14 region or surface (provided by the foraminous belt 32), two side surfaces (defined by the
15 positioning of finger rails 925, 950) and lower surface (provided by the upper surface face 1030
16 of the entrance cone 144). The garniture conveyor belt 130 conveys the wrapper web 55 across
17 the upper surface 1030 of the entrance cone 144. After the tobacco filler 20 is deposited onto the
18 advancing paper web 55, the semicircular configuration of a portion of the upper surface 1030 of
19 the entrance cone 144 helps form the paper web 55 and the stream of tobacco filler 20 thereon
20 into a rod-like shape having the desired cross-sectional shape (e.g., generally circular). The
21 upper surface 1030 of the garniture entrance cone 144 can be chemically or physically surface-
22 treated, if desired. For example, the garniture entrance cone upper surface 1030 can be treated so
23 as to have a surface of a ceramic material having a low coefficient of friction.

24 Each of the opposing edges 1130, 1132 at each end of the inside surface 88 of the paper
25 web 55 can have the tendency to come into contact with the lower region of the finger rail
26 assembly 140, and in particular, the lower regions or downwardly protruding arms or portions of
27 each respective finger rail 925, 950. Typically, the inside surface 88 of portions of the paper web
28 55 come into contact with portions of the finger rail assembly 140 above the entrance cone 144.
29 When the inside surface 88 of the paper web 55 has been coated with an additive material 73
30 (that can have the form of an adhesive-type coating formulation), and the inside surface 88 of the
31 paper web 55 reaches the garniture entrance cone 144 and finger rail assembly 140, that additive

1 material still can be wet, tacky or sticky. As a result, some of that additive material 73 can
2 exhibit a tendency to stick onto portions of the finger rail assembly 140.

3 A fast moving gas stream exits the finger rail 140 assembly in the region in the bottom
4 region of finger rails 925, 950; but above the paper web 55. The fast moving gas stream is
5 provided from a suitable source, such as a laboratory-type pressurized or compressed air source
6 (not shown). The temperature of the gas can vary, and air of essentially ambient temperature,
7 heated air or cooled air can be used. Although not preferred for most applications, the gas
8 stream can comprise steam. Preferably, air flow is provided through a T-type connection tube
9 (not shown) connected to a supply tube such that air enters the air inlet passageways (not shown)
10 and into the respective manifolds 934, 954 through the respective back faces of each finger rail.
11 The downward force of the air stream, as well as a suitably designed pattern of airflow from the
12 finger rail assembly (e.g., such as a staggered pattern of air distribution outlets (not shown))
13 results in the creation of a zone of air turbulence above the paper web 55. The downward forces
14 created by such an air stream act to maintain the paper web 55, and particularly the opposing
15 edges 1130, 1132 thereof, spaced away from the adjacent surfaces of the finger rail assembly
16 140. Consequently, as the paper web 55 advances underneath the finger rail assembly 140, the
17 additive material 73 on the inside surface 88 of the paper web 55 is effectively prevented from
18 being transferred to lower regions of the finger rail assembly 140. As a result, the air above the
19 paper web 55 is sufficiently agitated to maintain the paper web a distance away from the lower
20 surfaces of the finger rails 925, 950. A staggered pattern of air distribution outlets assists in
21 avoiding the formation of a laminar-type air flow down onto the advancing paper web 55.
22 Certain downwardly directed air flows patterns (e.g., certain patterns that are not turbulent in
23 nature) can have a tendency to produce a zone of low air pressure above the paper web 55, and
24 such types of air flow patterns can result in the paper web being drawn into contact with the
25 lower surface region of the finger assembly 140.

26 Additionally, a fast moving gas stream can exit manifold 1058 through longitudinally
27 extending air slots 1050, 1052 extending within the upper surface 1030 of entrance cone 144 can
28 be positioned in alignment, such that air flow is directed toward the edges 1130, 1132 of the
29 paper web 55. The fast moving gas stream is provided from a suitable source (not shown). The
30 temperature of the gas can vary, and air of essentially ambient temperature, heated air or cooled
31 air can be used. Although not preferred for most applications, the gas stream can comprise

1 steam. The previously described downward force of the air stream provided from the modified
2 finger rail assembly 140, as well as a suitably designed pattern of airflow from the entrance cone
3 144, results in the creation of a low air pressure zone 1200 below the paper web 55. The
4 downward forces created by such an air stream act to maintain the paper web 55, and particularly
5 the opposing edges 1130, 1132 thereof, spaced away from the adjacent surfaces of the finger rail
6 assembly 140. That is, the paper web 55 is effectively drawn away from the finger rail assembly
7 140. Additionally, the entrance cone air outlets 1050, 1052, or other suitable air exit or
8 distribution means, are directed toward each of opposing edges of the paper web that overlies
9 that entrance cone. Thus, the direction of air flow through the longitudinal air slots 1050, 1052
10 of the entrance cone 144 relative to the edges 1130, 1132 of the paper web 55 causes the
11 formation of a low air pressure zone 1200 below the paper web 55. The edges 1130, 1132 of the
12 paper web 55 are caused to be drawn down onto the respective upper lateral aspects 1040, 1042
13 of the entrance cone concave upper surface 1030. Those edges 1130, 1132 are thereby
14 effectively pulled away from contact with components of the finger rail assembly 140. As a
15 result, transfer of the additive material 73 from the inside surface 88 of the paper web 55 is
16 avoided, minimized or prevented from being transferred to the finger rail assembly 140, as the
17 paper web 55 advances underneath that assembly.

18 Air flow from the finger rails 925, 950, from the entrance cone 144, or from a
19 combination of air flow from both the finger rails 925, 950 and from the entrance cone 144
20 allows air flow rates from above, below, or both from above and below, the paper web 55. As
21 such, a desirable smooth movement of the paper web 55 between the finger rail assembly 140
22 and the entrance cone 144 is facilitated, while maintaining the paper web 55 a desirable distance
23 away from components of the finger rail assembly. The degree of air flow through the finger
24 rails 925, 950 and through the entrance cone 144 that is sufficient to achieve optimum operation
25 can be determined by experimentation and can be a matter of design choice.

26 Referring to Figure 15, there is shown a block diagram of registration and inspection
27 systems 1500 representative of various aspects of the present invention. Such a system 1500 is
28 useful for inspecting and assisting in the control of manufacture of cigarettes (not shown) that are
29 manufactured from a continuous paper web 55 possessing a predetermined pattern, such as a
30 plurality of bands 1505, 1506, 1507, 1508. The paper web 55 is routed near a detection system
31 95. The detection system can be spectroscopic system, such as a non-contact ultrasonic

1 transmission system or a near infrared (NIR) absorption system. Such a detection system can be
2 characterized as a non-optical type of detection system. A typical detection system 95 includes a
3 transducer/sensor component 1510 and a processor/analyzer component 1512. A typical
4 ultrasonic detection system 95 utilizes a transducer and an analyzer. A preferred ultrasonic
5 detection system is available as Model NCT 210-P2 6.3mm 1MHz transducer 1510 and NCA-
6 1000 2 EN analyzer 1512, available from SecondWave Systems Corp. A typical NIR system 95
7 utilizes a sensor and a processor. A preferred NIR detection system utilizes a GD 100W NIR
8 sensor 1510 with a 100 microsecond response time and G-NET Verification System processor
9 1512, available from Nordson Corporation. Typically, detector systems 95 possess response
10 times sufficient to provide adequate information regarding a continuous paper web 55 that is
11 moving at speeds customary on conventional cigarette making machines.

12 NIR reflectance systems are particularly preferred spectroscopic systems for inspecting
13 samples, such as paper webs that are considered to be opaque. See, *Near-Infrared Technology in*
14 *the Agricultural and Food Industries*, edited by Phil Williams and Karl Norris, Published by the
15 American Association of Cereal Chemists, Inc. St. Paul, Minnesota, USA. Typically, the
16 radiation emission source and detector 1510 are housed in the sensor body, and a fiber optic
17 bundle guides the incident light to the paper web through a focusing lens in order to achieve a
18 spot size of about 3 mm. Typically, the reflected radiation is collected by the same lens and fiber
19 optic bundle, and directed back to the detector 1510. Such components of such a system
20 typically have a response time of about 100 microseconds, which is sufficiently fast to detect
21 bands on a cigarette making machine running at speeds sufficient to produce about 8,000
22 cigarette rods per minute, and having either 1 or 2 bands per cigarette rod. For example, for a
23 tobacco rod length of 60 mm, a nominal tobacco rod making speed of 8,000 rods per minute, and
24 a single band of adhesive of 5 mm width per rod, the detection time for each rod is about 625
25 microseconds.

26 NIR spectroscopy measures the chemical concentration of constituents in a sample in the
27 wavelength range of about 850 nm to about 2500 nm. Radiation within such wavelengths can be
28 generated using gratings, band pass interference filters, diodes or high speed electronically
29 controlled acousto-optic transmission filters (AOTF). Exemplary detectors used in NIR
30 spectrophotometric systems are lead sulfide (PbS), silicon (Si) and indium gallium arsenide
31 (InGaAs) detectors. NIR-based systems can be used to detect the presence of chemical

1 constituents, such as water, other components of the coating formulations applied to the paper
2 web, or marker materials that are incorporated into the coating formulations. For many additive
3 formulations that are applied to paper webs in accordance with the on-line application techniques
4 of the present invention, those formulations incorporate water (e.g., in many instances at least
5 about 40 weight percent, and usually at least about 50 weight percent of the applied coating
6 formulation is water). Water has strong absorbance bands at 1450 nm and 1940 nm.

7 A PLC-based control system 1518 provides overall supervisory control of the cigarette
8 manufacturing process. For example, the PLC-based control system 1518 can receive, process
9 and provide process control information concerning pattern application of additive material to
10 the paper web 55, inspection of the paper web, conditions associated with drying of additive
11 material that has been applied to the paper web, and rejection of cigarettes that do not meet
12 certain specifications. A suitable PLC-based system is available as SIMATIC S7-300 controller
13 model 6ES7 315-2AF03-0AB0 available from Siemens Energy and Automation, Incorporated.

14 During cigarette manufacture, when the cigarette making machine reaches the preset
15 speed, and cigarette production is underway, the cigarette making machine 10 sends a high speed
16 enable signal 1522 to the PLC 1518. The PLC processes that signal and generates an output
17 signal 1524 to a servo control system 1525, which in turn, instructs the servo motor (not shown)
18 to engage the additive applicator apparatus 70 for operation (i.e., the roller system is instructed to
19 position itself into operative engagement and begin operation for additive material application).
20 An output signal 1530 representative of the pattern sensed by the detection system 95 is sent to
21 the PLC 1518 for processing, and the PLC determines, among other things, if there is a fault and
22 if cigarette rod rejection is required. In addition, the detection system 95 sends a second signal
23 1533 (i.e., a tolerance fault) that indicates if pattern deviation (e.g., a band width deviation) is
24 within or beyond a predetermined tolerance level. If a band 1507, 1508 is missing or out of
25 tolerance (i.e., is an incorrect size), such an event is noted and the PLC determines whether to
26 reject 1536 a cigarette or shut down 1538 the cigarette making machine 10, by communication
27 with the cigarette making machine. Internal shift registers 1541 within the PLC 1518 are used to
28 keep track of the reject cigarette rod information sent to the cigarette maker control system for
29 rejection of the reject tobacco rods at the selected downstream rejection location (not shown).
30 The PLC also determines if system shut down is required (e.g., if consecutive sets of rejects
31 above a set value thereby indicating a major or catastrophic fault requiring machine operator

1 intervention), and the shutdown signal 1538 is sent to the control system (not shown) within the
2 cigarette making machine 10. The reject signal 1536 is also sent to a database 1545 for
3 recording to compute efficiency information, and any faults generated by the PLC 1518 are sent
4 through the cigarette making machine control system (not shown) to a graphical display 1550 for
5 feed back to the machine operator. Information 1551 from the cigarette making machine 10 also
6 is sent to the database 1545.

7 For a system 1500 designed to detect applied patterned bands 1507, 1508 on a paper web
8 55, such a detection system receives two input signals 1560, 1562. For example, the first signal
9 1560 can be a trigger signal that corresponds to a 1:1 ratio with the flying knife cut position 1568
10 of the continuous tobacco rod (i.e., one cut is represented by one pulse), and the second signal
11 1562 being an encoder signal that corresponds to the speed 1575 of the continuous cigarette rod.
12 In addition to the presence or absence of an applied band, the position of such a band within a
13 rod and the width of that band can be determined by the combination of these two in put signals
14 1560, 1562.

15 Certain cigarette making machine components can be driven using a servo drive control
16 system 1525, or other suitable motion control means. Using servo control systems 1525, the
17 speed, acceleration rate, position, and torque of a motor (not shown) can be programmed
18 digitally. An internal encoder 1580 is integrated into the motor housing (not shown) for an
19 internal feed back for the servo motor (not shown). A servo-based drive control system
20 comprises a controller/amplifier and a servo motor that is used to match or synchronize with the
21 speed of the continuous cigarette rod in order to apply and position a desired pattern (e.g., one or
22 two bands) on what is ultimately each individual cigarette rod. This is accomplished by using
23 input signals 1585, 1587 from an encoder 1590. Signal 1585 from encoder 1590 that is
24 mechanically linked to a suitable rotating shaft (not shown) of the cigarette rod making machine
25 provides information regarding the speed and position of the cut-off knife. In addition, the
26 second signal 1587 is timed to the cut of point of the cut-off knife 1590 in order to reference the
27 cut position of each individual cigarette rod. The detector 95 detects the presence of the additive
28 material applied on the paper web, and signal 1530 also is fed to the servo controller 1580. This
29 signal is processed 1525; and the result is compared to a previously determined, pre-programmed
30 acceptance positional window. That is, the output signal 1530 concerning that detected
31 information (e.g., information regarding positioning of a band 1507 on the paper web 55) is

1 compared to that of what is expected for a paper web that is within desired specifications. The
2 servo controller 1525 also receives a signal 1598 from encoder 1575 to synchronize the operation
3 of the applicator apparatus 70 with the speed of operation of the cigarette making machine 10.
4 As such, the servo controller 1525 directs the applicator apparatus 70 to (i) correct the operation
5 of the application apparatus so as to provide corrected and proper registration by phase
6 adjustment in the servo control system, and (ii) generates out of register fault 1600 to cause
7 further processing within the PLC 1518 to determine whether to reject cigarettes that are not
8 within certain specified specifications or to shut down the cigarette making machine. For
9 example, when a band 1507 that is applied to the paper web 55 is out of registration, the servo
10 motor temporarily speeds up or slows down to allow the positioning the pattern of additive
11 material on the paper web to return back within the desired and specified registration.

12 Registration of the transversely positioned bands of additive material on a continuous
13 paper web so as to be within a tolerance window is a very desirable feature when those bands are
14 used for the production of cigarettes that meet certain standards with regards to low ignition
15 propensity criteria. In accordance with one aspect of the present invention, registration of the
16 patterns (e.g., bands) applied to continuous paper webs within a tolerance window can be carried
17 out whether the patterns are applied off-line (e.g., as pre-printed patterns) or on-line (e.g., as
18 patterns applied on the cigarette making apparatus). In particular, a 2-axes control system (i.e., a
19 system that controls two independent motors) is used within the cigarette making apparatus in
20 conjunction with a high speed band sensor (i.e., which is fast enough to respond to nominal
21 cigarette making speeds). A first servo motor drives the flying knife of the cigarette making
22 machine. The knife position at rod cut off location is derived by an encoder mechanically
23 coupled to the cut off knife, and this signal is used as a reference point for determining the
24 position of the band. A second servo motor drives the garniture belt and the foraminous
25 conveyor belt, and a second encoder provides the feedback regarding cigarette making speed.
26 The detector senses a band and the location of that band with respect to the cutoff knife. If the
27 bands are out of registration on the cigarette rods, the servo control system typically slows down
28 the garniture belt relative to the cut off knife so that the knife temporally will cut shorter rods
29 until the continuous tobacco rod is in registration. This can be achieved either by speeding up the
30 cut off knife or slowing down the garniture belt. For example, the system can be programmed to
31 make a small adjustment per rod (e.g., such as 1 mm per cut change per rod) so as to walk the

1 system into to registration as smoothly as possible. However, for smaller adjustments, longer
2 periods are required to bring the cigarette rods back within the tolerance window, and hence
3 more short cigarettes will be rejected. Such a registration system is particularly useful for
4 making adjustments (i) during cigarette making machine start up; (ii) during machine operation
5 after recovery from a shutdown or after a new bobbin of paper web is spliced into the machine;
6 (iii) during normal cigarette making machine operation due to factors such as stretching of the
7 paper web.

8 Referring to Figure 16, there is shown an additive application control system timing
9 diagram for band registration on a continuous paper web. The band on the paper web is detected
10 by a sensor, and a corresponding output signal is generated. A signal that coincides to the cut off
11 location of a cigarette rod also is generated. A related signal corresponding to the position of the
12 rod relative to the cut-off knife location on the cigarette rod also is generated. The sensor output
13 is compared to the other two signals. Such a comparison allows for the determination of location
14 of the sensed band, and determination that the location is within an acceptable specified window.
15 Thus, for example, it is possible to consistently produce a plurality of cigarette rods, each
16 cigarette rod possessing one band having a width of 5 mm that is positioned 25 mm from the
17 lighting end of each such cigarette rod. Alternatively, for example, it is possible to consistently
18 produce a plurality of cigarette rods, each rod possessing at least two identical bands (e.g., each
19 having a width of about 7 mm), and the spacing between the bands, measured from the inside
20 adjacent edges of the bands, is no less than 15 mm and no greater than 25 mm.

21 Referring to Figure 17, there is shown an additive application control system timing
22 diagram for band registration on a continuous paper web, and two bands are shown as being out
23 of position. The band on the paper web is detected by a sensor, and an output signal is generated.
24 A signal that coincides to the cut off location of a cigarette rod also is generated. A related
25 signal corresponding to the position of the rod relative to the cut-off knife location on the
26 cigarette rod also is generated. The sensor output is compared to the other two signals. Such a
27 comparison allows for the determination of location of the sensed band, and determination that
28 location is not within an acceptable specified window (i.e., whether the band is leading or
29 lagging). Thus, the servo control system can be used to adjust operation of the application
30 apparatus back into registration by phase correction. In addition, a fault signal for both leading
31 or lagging bands which do not fit into the expected registration window are generated for all the

1 out of registration rods, and sent to the PLC for processing for rejection at the proper location of
2 the system.

3 Referring to Figure 18, there is shown an additive application control system timing
4 diagram for band registration on a continuous paper web, and that band is shown to be too
5 narrow to meet specifications. The band on the paper web is detected by a sensor, and an output
6 signal is generated. A related signal corresponding to the position of the rod relative to the cut-
7 off knife location on the cigarette rod also is generated. The sensor output is compared to the
8 other two signals. Such a comparison allows for the determination of width of the sensed band,
9 and determination that width is not within an acceptable specified window. A fault signal for
10 that out of specification band is sent to the PLC for further processing for rejection or shut down
11 of the cigarette maker.

12 Referring to Figure 19, there is shown an additive application control system timing
13 diagram for band registration on a continuous paper web, and that band is shown to be too wide
14 to meet specifications. The band on the paper web is detected by a sensor, and an output signal is
15 generated. A related signal corresponding to the position of the rod relative to the cut-off knife
16 location on the cigarette rod also is generated. The sensor output is compared to the other two
17 signals. Such a comparison allows for the determination of width of the sensed band, and
18 determination that width is not within an acceptable specified window. A fault signal for that out
19 of specification band is sent to the PLC for further processing for rejection or shut down of the
20 cigarette maker.

21 Referring to Figure 20, there is shown a schematic illustration of portion of a cigarette
22 making machine 8 having yet another additive applicator apparatus representative of one aspect
23 of the present invention. A portion of a conventional PROTOS cigarette maker 10 manufactured
24 by Hauni-Werke Körber & Co. KG of Germany is shown. The maker 10 is modified to comprise
25 an additive applicator apparatus 70. The cigarette maker 10 includes a large bobbin 58 with a
26 strip 55 of paper web, or cigarette wrapper, wound thereon. Bobbin 58 is mounted for clockwise
27 rotation beneath the cigarette maker garniture 45 and printer section 1620. As the strip 55 of
28 paper web, or wrapper, is unwound from the bobbin 58, it passes around an arrangement of
29 rollers (shown as rollers 60, 61) to take up any slack in the strip 55 and maintain a certain
30 amount of tension on the paper strip.

1 After the paper strip 55 passes through the printer section 1620, it travels to the additive
2 applicator apparatus region 1625, where it first passes through a paper preheater 1628. The
3 additive applicator 70 is arranged between the bobbin 58 and the garniture 45, and preferably is
4 employed to apply bands of adhesive-type material to the moving paper strip 55. The preheater
5 1628 is preferably an infrared heater, which preheats the paper web 55 to a temperature in the
6 range of about 180° C to about 220° C. Preheating of the paper web 55 is optional, but can be
7 preferred, especially in the case of a high speed cigarette maker when preheating the paper can
8 advantageously assist in evaporating the solvent for the subsequently applied additive.

9 The preheated paper web 55 travels next to the additive applicator assembly 70,
10 sometimes broadly referred to as a "glue pot." The additive applicator assembly 70 comprises a
11 pair of counter-rotating rollers 78, 82, which counter-rotate in the directions shown by the
12 arrows. The additive applicator assembly 70 further comprises an additive feed shoe 448. A
13 drip box 465 encloses the lower portions of the rollers 78, 82 to catch any additive that drips,
14 spatters, or is thrown by centrifugal force or otherwise from the rollers. Rollers 78, 82 are
15 engaged to counter-rotate at identical peripheral speeds, which also correspond to the speed of
16 the paper strip 55 at the point 1638 where the paper strip tangentially contacts the peripheral
17 surface of roller 82. Conventional speed control systems are useful for moving and rotating
18 machine components at precise predetermined speeds and for maintaining zero relative speed
19 between moving and rotating machine components.

20 Roller 82 is an application roller and roller 78 is a pattern roller, preferably a gravure or
21 intaglio pattern roller provided with a plurality of circumferentially-spaced transverse grooves, or
22 pockets. Additive feed shoe 448 is located between the counter-rotating rollers 78, 82 so as to
23 feed additive material to the pattern roller 78 immediately upstream of the nip between the
24 rollers. Additive material includes adhesives, such as a cigarette seam adhesive, filter plug wrap
25 adhesive, tipping paper adhesive, or the types of additive materials set forth hereinafter. As the
26 rollers 78, 82 counter-rotate, the additive material or adhesive is transferred from the transverse
27 pockets, or grooves, on the pattern roller 78 to the application roller 82 in circumferentially-
28 spaced locations on the peripheral surface of the application roller. The application roller 82 is
29 positioned to bear with a slight upward pressure against the paper strip 55 at point 1638 so as to
30 transfer the additive material to the optionally preheated paper strip 55 in longitudinally-spaced,
31 cross-directional bands (not shown) of a predetermined width and spacing.

1 After the additive material has been applied to the paper strip 55, the paper strip passes
2 through an infrared paper dryer 120 downstream of the additive applicator assembly 70 and
3 upstream of the garniture 45 of the cigarette maker 10. After passing through the dryer 120, the
4 paper strip 55 with the cross-directional bands on one surface thereof travels via another
5 arrangement of rollers 1640 to the garniture 45 where it is formed about a tobacco rod and
6 bonded along an overlapping longitudinal seam formed by the longitudinal side edges of the
7 paper strip 55. The additive material and the paper strip 55 are dried sufficiently in the infrared
8 paper dryer 120 and during passage over the roller arrangement 1640 so that the paper with the
9 spaced, cross-directional adhesive bands applied to it does not tear when it is wrapped about the
10 tobacco rod in the garniture 45.

11 The additive applicator apparatus 70 causes the additive bands to be applied to the inside
12 surface of the paper cigarette wrapper (i.e., the surface confronting the tobacco rod) as is
13 preferred. However, the additive applicator apparatus 70 can be arranged on the cigarette maker
14 10 so that the bands of additive material can be applied to the outside surface of the paper
15 cigarette wrapper, if that is desired.

16 Referring to Figure 21, there is shown a portion of a cigarette making machine assembly
17 8; and there also are shown relevant components of another representative additive applicator
18 apparatus 70. Such an applicator 70 is particularly useful for applying to a paper web 55 certain
19 types of viscous additive materials. Such additive materials useful in applications involving
20 cigarette paper include, for example, paste-type formulations of additive materials having
21 viscosities in the range of about 500,000 centipoise to about 2,500,000 centipoise.

22 Additive applicator 70 is an assembly that includes a pick-up roller 720 and a transfer
23 pressure roller 725 (or back-up roller) mounted on each side of an application roller 1800. Those
24 rollers are mounted through a front roller plate 730 secured to the front exterior region of a
25 cigarette making machine. Each of a plurality of rollers 426, 428, 430, 432 is fixedly mounted to
26 the front roller plate 730; and those rollers provide guides for a path over which the paper web 55
27 travels from a bobbin (not shown) to the additive applicator 70 and on to other regions of the
28 cigarette making machine 8.

29 The pick-up roller 720 (shown in phantom) is positioned within a reservoir 740 for the
30 additive material (not shown). The reservoir is maintained in place and secured to the front
31 roller plate 730 by bolts 1810, 1812 or other suitable connection means. The reservoir 740 is

1 connected to a source (not shown) of additive material (e.g., a formulation having the form of a
2 paste), through port 1820 near the top region of the reservoir 740. As such, a source of additive
3 material for the pick-up roller 720 is provided. If desired, the reservoir can be equipped with
4 devices for monitoring the amount of additive material that is present within that reservoir, such
5 as are described hereinbefore with reference to Figure 4. Typically, the additive material is
6 supplied through tubing (not shown), such as Tygon-type or polyethylene tubing, that feeds the
7 reservoir 740 through port 1820. The reservoir of the additive applicator 70 provides a
8 receptacle for the additive material to the point of deposit onto the pick-up roller 720.

9 A doctor blade 1822 is positioned near the pick-up roller 720 near the top region of that
10 roller. The doctor blade can be supported in a fixed position relative to the roller, or the doctor
11 blade can be adjustable, for example, by being mounted in so as to be moveable using
12 micrometer 1824. As such, the positioning of the doctor blade 1822 relative to the roll face of
13 roller 720 can be adjusted. Preferably, the doctor blade is positioned in order that additive
14 material that has been applied to the roll face of the pick-up roller is provided in the desired
15 amount. Typically, the doctor blade is positioned so as to provide a layer of additive material on
16 the roll face of the pick-up roller that has the desired thickness, both along the length and width
17 of the roll face. Typically, the doctor blade 1822 is positioned about 0.001 to about 0.002 inch
18 from the surface of the roll face of pick-up roller 720. After the additive material on the roll face
19 of the pick-up roller has been provided in the desired amount, that additive material is transferred
20 from the pick-up roller to the face of appropriate die 1840 of applicator roller 1800.

21 The pick-up roller 720 preferably is manufactured from a material that can vary, but
22 preferably is manufactured from an elastomeric type material, such as a polyurethane rubber type
23 material, a natural gum rubber, ethylene-propylene diene monomer rubber, or the like. An
24 exemplary pick-up roller has a diameter of about 50 mm to about 100 mm. For the embodiment
25 shown, the pick-up roller rotates counter-clockwise within the reservoir 740, and additive
26 material within the reservoir is deposited on the surface of that roller.

27 The pick-up roller 720 is in roll contact with a plurality of protruding applicator dies
28 1840, 1842, 1844, 1846 of application roller 1800. The application roller dies preferably are of
29 the general dimension of the pattern of additive material that is desired to be applied to the paper
30 web 55. An exemplary application roller 1800 is manufactured from stainless steel, elastomeric
31 material, or a combination of those materials. For example, the larger wheel portion of the

1 applicator roller can be manufactured from stainless steel, and the protruding dies can be
2 manufactured as replaceable inserts manufactured from relatively soft elastomeric materials.
3 Alternatively, the wheel and die component parts of the applicator roller can be manufactured
4 from a hard metal material, such as stainless steel. An exemplary applicator roller has a diameter
5 of about 50 mm to about 100 mm, and typically about 85 mm; and possesses four protruding dies
6 each of about 10 mm to about 15 mm in height, about 22 mm to about 25 mm in width, and
7 about 5 mm to about 8 mm in circumferential length. Other sizes and shapes of the dies, other
8 configurations of the dies on the roller, other roller sizes, and the composition of components
9 used to manufacture the roller, can be a matter of design choice. For the embodiment shown,
10 application roller 1800 rotates clockwise.

11 In a preferred embodiment, each roller 725, 1800 is driven independently. For example,
12 one servo drive (not shown) can control the rotation of transfer roller 725, and a second servo
13 drive (not shown) can control the applicator roller 1800. Controlling operation of the two rollers
14 725, 1800 with independent servo system allow for independent control of speeds of those two
15 rollers, and hence, the ability to tightly control the tolerances associated with application of
16 additive material to the paper web using those two rollers. Rollers that are independently
17 adjustable also are preferred in that the degree of touching of the roll faces of the respective
18 rollers during roll contact can be controlled. For example, roller lift bracket 798 is slidably
19 adjustable about pivot plate 1806 by means of actuation by air cylinder 1805 to move roller 725
20 into and out of roll contact with paper web 55 and protruding dies 1840, 1842, 1844, 1846 of the
21 applicator roller 1800.

22 In operation, the continuous paper web 55 passes between the roll faces of the transfer
23 roller 725 and the application roller 1800. As a result of the contact experienced by the paper
24 web 55 as it travels between the roll faces of the transfer pressure roller 725 and the applicator
25 roller 1800, additive material transferred to the surfaces of the protruding dies 1840, 1842, 1844,
26 1846 from the surface of the applicator roller 720 is applied to the paper web 55 in a
27 predetermined pattern. As such, the die faces provide a type of off-set printing of additive
28 material to desired locations on the moving paper web. Movement of the transfer pressure roller
29 725 can be programmed, such as by a microprocessor associated with the operation of the cigarette
30 making machine. Such control by a signal received from the cigarette making machine can
31 allow for retraction of the pressure roller from the paper web 55 so as to not be in contact with

1 the various rollers when the cigarette making machine is not in normal operation; and as such,
2 problems associated with sticking of the paper web to various components of the applicator
3 apparatus 70 are minimized, avoided or prevented.

4 Referring to Figure 22, there is shown a portion of a cigarette making machine assembly
5 8; and there also are shown relevant components of another representative additive applicator
6 apparatus 70. Such an applicator 70 is particularly useful for applying to a paper web 55 certain
7 types of viscous additive materials. Such additive materials useful in applications involving
8 cigarette paper include, for example, paste-type formulations of additive materials having
9 viscosities in the range of about 500,000 centipoise to about 2,500,000 centipoise.

10 Additive applicator 70 is an assembly that includes a pick-up roller 720 in roll contact
11 with an applicator roller 1800. Those rollers are mounted through a front roller plate 730
12 secured to front exterior of a cigarette making machine. Each of a plurality of rollers 422, 426, is
13 fixedly mounted to the front roller plate 730; and those rollers provide guides for a path over
14 which the paper web 55 travels from a bobbin (not shown) to the additive applicator 70 and on to
15 other regions of the cigarette making machine 8.

16 The pick-up roller 720 (shown in phantom) is positioned within a reservoir 740 for the
17 additive material (not shown). The reservoir is maintained in place and secured to the front
18 roller plate 730 by bolts 1810, 1812 or other suitable connection means. The reservoir 740 is
19 connected to a source (not shown) of additive material (e.g., a formulation having the form of a
20 paste), through port 1820 near the top region of the reservoir 740. As such, a source of additive
21 material for the pick-up roller 720 is provided. Typically, the additive material is supplied
22 through tubing (not shown), such as Tygon-type tubing or polyethylene tubing, that feeds the
23 reservoir 740 through port 1820.

24 A doctor blade 1822 is positioned near the pick-up roller 720 near the top region of that
25 roller. The doctor blade can be mounted in a fixed position relative to the roll face of the roller.
26 The doctor blade also can be adjustable, for example, by being positioned so as to be movable
27 using a micrometer 1824. As such, the positioning of the doctor blade 1822 relative to the roll
28 face of roller 720 can be adjusted. Preferably, the doctor blade is positioned in order that
29 additive material that has been applied to the roll face of the pick-up roller is provided in the
30 desired amount. Typically, the doctor blade is positioned so as to provide a layer of additive
31 material on the roll face of the pick-up roller that has the desired thickness, both along the length

1 and width of the roll face. Typically, the doctor blade 1822 is positioned about 0.001 to about
2 0.002 inch from the surface of the roll face of pick-up roller 720. After the additive material on
3 the roll face of the pick-up roller has been provided in the desired amount, that additive material
4 is transferred from the roll face of the pick-up roller to appropriate locations on the paper web
5 55.

6 The pick-up roller 720 preferably is manufactured from a material that can vary, (e.g., the
7 material can be a soft material or a hard material), but preferably the material is manufactured
8 from an elastomeric type material, such as a polyurethane rubber type material, or other suitable
9 material. An exemplary pick-up roller is described previously with reference to Figure 21. The
10 pick-up roller rotates clockwise (for the embodiment shown) within the reservoir 740, and
11 additive material within the reservoir is deposited on the surface of the roll face of that roller.

12 The pick-up roller 720 is in roll contact with protruding applicator cams 1840, 1842,
13 1844, 1846 of application roller 1800. The application roller cams are of the general dimension
14 of the pattern of additive material that is desired to be applied to the paper web 55. An
15 exemplary application roller 1800 is described previously with reference to Figure 21. For the
16 embodiment shown, application roller 1800 rotates counter-clockwise.

17 In a preferred embodiment, each roller 725, 1800 is driven independently. For example,
18 one servo drive (not shown) can control the rotation of transfer roller 725, and a second servo
19 drive (not shown) can control the applicator roller 1800. Controlling operation of the two rollers
20 725, 1800 with independent servo systems allow for independent control of speeds of those two
21 rollers, and hence, the ability to tightly control the tolerances associated with application of
22 additive material to the paper web using those two rollers.

23 In operation, the continuous paper web 55 passes between the roll faces of the pick-up
24 roller 720 and the application roller 1800. As a result of the contact experienced by the paper
25 web 55 as it travels between pick-up roller 720 and the applicator roller 1800, additive material
26 transferred by the surfaces of the protruding cams 1840, 1842, 1844, 1846 from the surface of
27 the applicator roller 720 is applied to the paper web 55 in a predetermined pattern. That is, the
28 protruding applicator roller cams on the side of paper web, opposite the pick-up roller and the
29 additive material, cause periodic deflection of the paper web toward the pick-up roller; and as
30 such, additive material is transferred from the surface of the pick-up roller to the paper web in a
31 controlled manner as a result of the camming action of the applicator roller. The paper web 55 is

1 routed in a manner such that the paper web has a tendency to move upwards and away from the
2 surface of the applicator pick-up roller when the various cams are not deflecting that paper web
3 downwards. As a result, control of the location of the application of additive material on the
4 paper web can be carried out.

5 Referring to Figure 23, there is shown a portion of a cigarette making machine assembly
6 8 of the present invention. In particular, there is shown an additive applicator apparatus 70
7 representative of one aspect of the present invention. Such an additive applicator 70 is
8 particularly useful for applying to a paper web 55 additive materials (not shown) that can have
9 relatively wide ranges of viscosities (e.g., formulations of additive materials that can be
10 considered to have forms ranging from liquid to relatively thick pastes).

11 Additive applicator 70 is an assembly that includes a pick-up roller 78 and a transfer
12 roller 82 mounted adjacent to each other, and mounted through a roller support plate 400 on the
13 exterior front face of the cigarette making machine assembly 8. Descriptions of various relevant
14 components of such an additive applicator apparatus 70 are set forth previously with reference to
15 Figures 3-7, 21 and 22. Various components of such an additive applicator 70 are manufactured
16 from suitable metals, such as cast or machined aluminum or stainless steel. The pick-up roller 78
17 and the transfer roller 82 preferably are manufactured from hardened stainless steel. An
18 exemplary pick-up roller has a diameter of about 80 mm to about 130 mm, and a total roll face
19 width of about 55 mm to about 80 mm. An exemplary transfer roller has a diameter of about 80
20 mm to about 130 mm, and a total roll face width of about 35 mm to about 50 mm. Several fixed
21 guide posts, air bars or rotatable guide rollers 420, 422, 424, are suitably fixedly mounted; such
22 as to either the front roller plate 400 or the chassis of the cigarette making machine assembly 8,
23 depending upon the desired location of those guide posts or rollers. Those guide posts or rollers
24 provide the path over which the paper web 55 travels from a bobbin (not shown) in the direction
25 shown by arrow 1900, past the additive applicator 70, and on to other downstream destinations
26 of the cigarette making machine assembly.

27 The additive applicator 70 also includes a manifold 444 positioned above an additive
28 material reservoir (not shown). That reservoir is located in the nip zone above pick-up roller 78
29 and transfer roller 82, and the general size and shape of that reservoir is determined by the
30 configuration of those rollers and control block 1902. As such, a type of puddle of additive
31 material is provided in the nip zone about those rollers. The positioning of the control block

1 1902 is maintained through the positioning of a reservoir front arm 452 and a reservoir rear arm
2 (not shown). Those reservoir arms are positioned above the pick-up roller 78, and are movable
3 about pivot pin 1907. The control block 1902 can be positioned up or down through the use of
4 an adjustable stop arm 1912. In addition to assisting in providing the boundaries of the reservoir,
5 the control block also provides internal and external porting (not shown) for supply additive
6 material (not shown) from an external source (not shown) and removal of excess additive
7 material for recycling or disposal.

8 The manifold 444 is attached to a manifold pivot plate (not shown), which is attached to
9 the front roller plate 400. Such attachment leaves the manifold 444 with the capability of
10 moving upward and downward about a manifold pivot pin (not shown). The manifold 444 can
11 be maintained in place during operation of the system through force provided by an air cylinder
12 1915. Tubing (not shown), such as Tygon-type or polyethylene tubing, or other suitable supply
13 means, is connected to the manifold 444 and originates at a source of additive material (not
14 shown) to provide an input of additive material to the reservoir (not shown). The assembly also
15 includes a collection pot 465 positioned adjacent to and slightly below the pick-up roller 78. The
16 collection pot 465 serves as a temporary collection location for excess additive material removed
17 from the pick-up roller 78. If desired, the reservoir can be equipped with devices for monitoring
18 the amount of additive material that is present within that reservoir, such as are described
19 hereinbefore with reference to Figure 4. The reservoir of the additive applicator 70 provides a
20 receptacle for the additive material to the point of deposit onto the pick-up roller 78.

21 Against the front side face of the transfer roller 82 is positioned a scraper 864. A
22 corresponding scraper (not shown) is positioned against the back side face of the transfer roller
23 82. The scrapers are formed as downwardly extending arms of the control block 1902. As such,
24 excess additive material on the surfaces of the side faces of the transfer roller 82 is scraped from
25 that roller as it passes the scraper. That material then exits at least one outlet port (not shown),
26 which is located within the control block 1902. Typically, two ports, one on each of the front
27 and rear sides of the transfer roller 82, are employed. Then, the excess material is removed
28 through tubes (not shown) to be recycled or discarded. A diaphragm pump (not shown) or other
29 type of suitable means for supply of vacuum can be used to evacuate excess additive material
30 from the system. As such, both side faces of the transfer roller 82 are subjected to surface
31 treatment by two scraper pieces arranged along the side of that roller, so as to remove

undesirable excess additive formulation from those surfaces, and hence, maintain those surfaces relatively clean by maintaining those surfaces relatively free of build up of coating formulation. If desired, further surface treatments of either or both of the pick-up roller and transfer roller with air streams, water spray, scrapes or brushes can be employed to assist in maintaining the surfaces of those rollers clean and to assist in reducing the generation of heat caused by friction.

The transfer roller 82 and the pick-up roller 78 are positioned into operative engagement with one another using a roller pressure plate 480. The roller pressure plate 480 is operably connected to an air cylinder 484, or other suitable means for applying force to rollers 78, 82. The air cylinder 484 utilizes compressed air to force the roller pressure plate 480 about a pressure plate pivot shaft 488 into and out of engagement with the transfer roller 82. That plate 480 applies pressure to the collection pot 465 to move that collection pot into engagement with a bearing housing (not shown) on the shaft of pick-up roller 78. Thus, intimate roll contact between the roll faces of transfer roller 82 and pick-up roller 78 can be provided. Movement of the roller pressure plate 480 to engage and disengage the pick-up roller 78 with the transfer roller 82 can be programmed, and as such a microprocessor associated with the operation of the cigarette making machine can be used to control movement of that plate 480.

In operation, pick-up roller 78 is rotated counter-clockwise and the transfer roller 82 is rotated clockwise. Hence, additive material introduced into the upper nip region (e.g., reservoir) between the rotating pick-up roller 78 and counter-rotating transfer roller 82 fills a grooved or recessed region (not shown) in the roll face of pick-up roller, and is retained on the roll face of the transfer roller in the region thereof adjacent that grooved or recessed region. As such, there is provided an assembly and method for continuously providing a predetermined supply of additive material to a predetermined region of the roll face of the transfer roller 82.

Additive applicator 70 is an assembly that also includes an application roller 1800 and a transfer pressure roller 725 (or back-up roller) mounted on each side of an application roller 82. Typically, the back-up roller 725 is manufactured from an elastomeric material; and exemplary back-up rollers are those that are used in cigarette making machines that are commercially available. Those rollers are mounted through a front roller plate 400 that is secured to the front exterior region of a cigarette making machine 8. Other back-up roller configurations, such as those types of configurations described previously with reference to Figures 5, 6 and 21, also can

1 be employed. The moving paper web 55 is passed between the roll faces of the application roller
2 1800 and the back-up roller 725.

3 The manner of arranging and mounting the various rollers can vary. For example, any or
4 all of the rollers can be designed so as to be mounted using a tapered shaft and spindle type of
5 configuration.

6 The transfer roller 82 is in roll contact with a plurality (e.g., twelve, or other selected
7 number) of protruding applicator dies 1840, 1842, 1844, 1846 of application roller 1800. The
8 application roller dies preferably are of the general dimension of the pattern of additive material
9 that is desired to be applied to the paper web 55. An exemplary application roller 1800 is
10 manufactured from stainless steel, elastomeric material, or a combination of those materials. For
11 example, larger central wheel portion 1920 of the applicator roller can be manufactured from
12 stainless steel, and the protruding dies within the outer roll face 1925 can be shaped
13 manufactured from a relatively soft or flexible elastomeric material. Alternatively, the
14 protruding dies can be manufactured as replaceable inserts manufactured from relatively soft or
15 flexible elastomeric materials. Exemplary elastomeric type materials, are materials such as a
16 polyurethane rubber type material, a natural gum rubber, silicon rubber, and ethylene-propylene
17 diene monomer rubber. Representative protruding dies and associated components fashioned
18 from elastomeric materials can be provided from polyurethane rubber materials of the types
19 available as Cytec Compound #TV-8070 Polyurethane 60-65 Durometer "A", Cytec Compound
20 #TV-8050 Polyurethane 40-45 Durometer "A", and Cytec Compound #TV-8090 Polyurethane
21 80-85 Durometer "A", from Cytec Inc. Alternatively, the wheel and die component parts of the
22 applicator roller can be manufactured from a hard metal material, such as stainless steel. An
23 exemplary applicator roller has a diameter of about 100 mm to about 200 mm, and typically
24 about 130 mm to about 170 mm; and possesses about four to about sixteen protruding dies each
25 of about 1 mm to about 4 mm in radial height, about 22 mm to about 25 mm in width, and about
26 5 mm to about 8 mm in circumferential length. Such an applicator roller can be used to apply to
27 one surface of a web of cigarette paper wrapping material spaced bands that are oriented
28 transversely to the longitudinal axis of that paper web. Other sizes and shapes of the dies, other
29 configurations of the dies on the roller, other roller sizes, and the composition of components
30 used to manufacture the roller, can be a matter of design choice. For the embodiment shown,
31 application roller 1800 rotates counter-clockwise.

1 For a representative embodiment, the pick-up roller 78 and the transfer roller 82 each
2 have diameters of about 103 mm. The transfer roller 82 has a roll face having a width of about
3 40 mm. The pick-up roller 78 has a roll face having a width of about 68 mm, and a groove
4 having a width of about 22.5 mm is located about equidistant from each side of that roller and
5 circumscribes the entire roll face of that roller. The groove has a depth that can vary, and the
6 depth of a representative groove is about 0.001 inch to about 0.003 inch. The application roller
7 has a width of about 23 mm; and has an inner roller having a diameter of about 130 mm, and an
8 outer face of polyurethane-type rubber material having a radial thickness of about 7 mm, and
9 extending from the outer face are twelve equally spaced dies each having a radial height of about
10 2.5 mm and a circumferential length of about 6 mm. Such an application roller 1800 can be used
11 to apply to a cigarette paper wrapper an adhesive formulation in the form of spaced bands that
12 are arranged to extend across at least a portion of the width of that wrapper, and that have widths
13 of about 23 mm and lengths of about 6 mm.

14 For another representative embodiment, the additive applicator 70 can be configured so
15 that it is possible to consistently produce a wrapping material having additive material applied
16 thereto and positioned thereon, such that the wrapping material so produced can be used to
17 manufacture a plurality of cigarette rods, each rod possessing at least two identical bands (e.g.,
18 each having a width of about 5 mm to about 7 mm), and the spacing between the bands,
19 measured from the inside adjacent edges of the bands, is no less than 15 mm and no greater than
20 25 mm.

21 In a preferred embodiment, each of the transfer roller 82 and the application roller 1800 is
22 driven independently. For example, one servo drive (not shown) can control the rotation of
23 application roller 1800, and a second servo drive (not shown) can control the transfer roller 82.
24 The rotation of the pick-up roller 78 relative to the rotation of the transfer roller 78 can be tightly
25 controlled (e.g., in terms of a timed speed of rotation) in the general manner described previously
26 with reference to Figure 4. Controlling operation of the various rollers with independent servo
27 systems allows for independent control of speeds of the two supply rollers (e.g., the pick-up and
28 transfer rollers) relative to the application roller, and hence, the ability to tightly control the
29 tolerances associated with application of additive material to the paper web using a multi-roller
30 system. Additionally, it is preferred that rollers that are independently adjustable, in that the
31 degree of touching of the roll faces of the respective rollers during roll contact can be controlled.

1 If desired, each of the application roller 1800, transfer roller 82 and pick-up roller 78 each can be
2 independently operated using three separate servo systems.

3 In operation, during the process of cigarette manufacture, the pick-up roller 78 is rotated
4 counter-clockwise, and the transfer roller 82 is rotated clock-wise. Those rollers are engaged in
5 contact by pressure supplied by the pressure plate 480. Additive material (not shown) is fed
6 from a source (not shown) to the manifold 444, and from the manifold to the reservoir (not
7 shown). As such additive material is introduced into the upper nip region between the roll faces
8 of the pick-up roller 78 and the transfer roller 82. Due to the continuous groove (not shown) in
9 the roll face of the pick-up roller, additive material has a tendency to fill that groove; and due to
10 the maintained roll contact between the pick-up and transfer rollers, additive material is applied
11 as a continuous stripe on a portion of the roll face of the transfer roller in the region thereof
12 adjacent the groove of the pick-up roller. The application roller 1800, which is in roll contact
13 with the transfer roller, rotates counter-clockwise. Hence, coating formulations, such as mixtures
14 incorporating modified starches and water, can be applied in the desired amount and in the
15 desired manner, on the appropriate region of the roll face of transfer roller, and that formulation
16 then can be efficiently and effectively transferred from the transfer roller to the appropriate
17 regions of the application roller. The continuous paper web 55 passes between the roll faces of
18 the transfer roller 1800 and the back-up roller 725. As a result of the contact experienced by the
19 paper web 55 as it travels between the roll faces of the transfer pressure roller 725 and the
20 applicator roller 1800, additive material transferred to the surfaces of the protruding dies 1840,
21 1842, 1844, 1846 from the surface of the applicator roller is applied to the paper web 55 in a
22 predetermined pattern. As such, the die faces provide a type of off-set printing of additive
23 material to desired locations on the moving paper web. As a result, the additive material on the
24 surface of the application roller 1800 is transferred to the inside surface of the advancing paper
25 web 55 at locations corresponding to the pattern on the roller face of the application roller.
26 Operation and interaction of the transfer roller 82 and application roller 1800 relative to one
27 another are such that the transfer roller supplies the desired amount of additive material to the die
28 faces of the application roller. Operation and interaction of the die faces of the application roller
29 1800 and the paper web 55 are such that additive material on successive die faces is applied at
30 predetermined and desired locations of the paper web. That is, the paper web 55 is supplied at a
31 very high rate of speed, and hence, the various rollers also rotate as a correspondingly high rate

1 of speed. The paper web 55 having additive material applied thereto then is advanced to
2 downstream locations of the cigarette making machine, or elsewhere within the apparatus.

3 Referring to Figure 24, there is shown a pick-up roller 78 that is representative of the type
4 of pick-up roller described previously with reference to Figure 24. The pick-up roller 78
5 possesses a roll face 1950, as well as a circumferentially extending groove 1955 that extends
6 completely around the periphery of the roll face. The width of the groove can vary, and can be
7 designed to provide a desired amount of additive material formulation (not shown). The depth of
8 the groove can also vary, and can be designed to provide a desired amount of additive material
9 formulation (not shown). The groove 1955 most preferably is positioned such that the recess in
10 the roll face of the roller is located between front side roll face surface 1960 and rear side roll
11 face surface 1962. As such, in operation, the roll face (not shown) of the transfer roller (not
12 shown) is in roll contact with side roll face surfaces 1960, 1962 of the pick-up roller 78; and a
13 hollow region (not shown) is formed in the region where those rollers are in roll contact, due to
14 the presence of the groove 1955 in the roll face 1950 of the pick-up roller. Although a preferred
15 embodiment possesses one continuous groove, other groove designs can be employed. For
16 example, a series of continuous grooves, grooves forming the shape of a grid, or other type of
17 pattern, can be employed.

18 Referring to Figure 25, there is shown an alternate type of application roller 1800 that is
19 representative of the type of application roller described previously with reference to Figure 23.
20 Such an application roller can be used as the application roller in the types of applicator systems
21 described previously with reference to Figures 21 and 22. The application roller possesses a
22 plurality of spaced dies 1840, 1842, 1844, 1846 positioned at desired locations on the roll face
23 1965 (e.g., the peripheral surface) of the roller 1800. The dies are provided from cylinders of
24 elastomeric material positioned in semi-circular types of recesses formed in the large central
25 region of the roller. A removable side plate 1969 helps assist in maintaining the dies in place on
26 the roll face of the roller.

27 Referring to Figure 26, there is shown an alternate type of application roller 1800 that is
28 representative of the type of application roller described previously with reference to Figure 23.
29 Such an application roller can be used as the application roller in the types of applicator systems
30 described previously with reference to Figures 21 and 22. The application roller possesses a
31 plurality of spaced dies 1840, 1842, 1844, 1846 positioned at desired locations on the roll face

1 1965 of the roller 1800. The dies 1840, 1842, 1844, 1846 are provided from cylinders of
2 elastomeric material positioned in outwardly extending insertion regions 1980, 1981, 1982,
3 1983, respectively, formed in the large central region of the roller. A removable side plate (not
4 shown) helps assist in maintaining the dies in place on the roll face of the roller.

5 Referring to Figure 27, there is shown an alternate type of application roller 1800 that is
6 representative of the type of application roller described previously with reference to Figure 23.
7 Such an application roller can be used as the application roller in the types of applicator systems
8 described previously with reference to Figures 21 and 22. The application roller possesses a
9 plurality of spaced dies 1840, 1842, 1844, 1846 positioned at desired locations on the roll face
10 1965 of the roller 1800. The dies are provided from cylinders of elastomeric material positioned
11 in corresponding semi-circular types of recesses formed in the large central region of the roller.
12 A removable side plate 1969 helps assist in maintaining the dies in place on the roll face of the
13 roller.

14 Referring to Figure 28, there is shown an alternate type of application roller 1800 that is
15 representative of the type of application roller described previously with reference to Figure 23.
16 Such an application roller can be used as the application roller in the types of applicator systems
17 described previously with reference to Figures 21 and 22. The application roller possesses a
18 plurality of spaced dies 1840, 1842, 1844, 1846 positioned at desired locations on the roll face
19 1965 of the roller 1800. The dies are provided from shaped pieces of elastomeric material
20 positioned in corresponding formed recesses 1980, 1981, 1982, 1983 (e.g., wedge-shaped types
21 of recesses) formed in the large central region of the roller. A removable side plate (not shown)
22 helps assist in maintaining the dies in place on the roll face of the roller.

23 Referring to Figure 29, there is shown a wrapping material supply machine 200. The
24 path of travel of the strip of paper web 55 from the first bobbin 224 us to the second bobbin 2100
25 is shown by the various arrows. Such a machine 200 possesses an ability to apply, in a
26 continuous fashion, a desired pattern of additive material 73 to a continuous strip of paper web
27 55 supplied from a first bobbin 224, and to rewind the resulting web so treated to form a second
28 bobbin 2100. Such a machine 200 can be used to apply a coating formulation (e.g., a water-
29 based starch-based formulation) to a continuous paper web 55 in an off-line manner. Then, the
30 second bobbin 2100 can be removed from the machine 200, stored as necessary, and mounted
31 onto a conventional type of automated cigarette making apparatus (not shown) in order to

1 manufacture cigarettes (not shown) using wrapping materials possessing patterned additive
2 material applied thereto. Of particular interest is the ability to employ an essentially unmodified
3 automated cigarette making apparatus to manufacture a continuous cigarette rod having a
4 patterned wrapping material possessing additive material applied thereto.

5 A suitable wrapping material supply machine 200 can be provided by appropriately
6 modifying a web supply unit available as SE 80 from Hauni-Werke Korber & Co. KG. See, for
7 example, U.S. Patent No. 5,156,169 to Holmes et al., which is incorporated herein by reference.
8 Other suitable unwind units, such those having the types of components set forth in U.S. Patent
9 No. 5,966,218 to Bokelman et al., also can be employed. The supply machine 200 includes a
10 frame 205 that supports at least one unwind spindle assembly 220 onto which a first bobbin 224
11 is mounted. Preferably, the supply machine 200 includes a second unwind spindle assembly 228
12 for a second bobbin (not shown), and a web splicing mechanism 232. Suitable unwind units, and
13 associated components, are commercially available from sources such as Hauni Maschinenbau
14 AG, Molins, PLC, Goebel Schneid-und Wichelsysteme, and Dusenbery Worldwide. The amount
15 of wrapping material contained on the bobbin 224 can vary. Typical bobbins that are mounted
16 on conventional automated cigarette making apparatus often contain a continuous strip of
17 wrapping material that is about 6,500 meters in length.

18 The paper web 55 is threaded through a tension sensor 236, which, in conjunction with a
19 braking component 239, is in connection with the shaft of the unwind spindle assembly. As
20 such, the combination of the tension sensor 236 and braking component 239 acts to maintain a
21 desired amount of tension on the paper web 55 as it is transferred from the bobbin 224. Braking
22 component systems for unwind units are commercially available, and the design and operation of
23 such types of systems will be readily apparent to those skilled in the art of automated cigarette
24 manufacturing system design and operation.

25 In operation, a continuous paper web 55 supplied from a bobbin 224 is routed through a
26 path defined by a series of idler rollers, guideposts, and air bars 245, 247, 255, 256. The paper
27 web 55 also is routed through an applicator system 70 that is used to apply a desired pattern of
28 additive material 73 to the paper web 55. A representative additive material 73 is a coating
29 formulation in a liquid, syrup or paste form. Optionally, though not preferred, the paper web can
30 be routed through a heating/cooling control unit (not shown) immediately before the paper web
31 passes through the applicator system 70.

1 A representative additive applicator 70 comprises components, and can be operated in
2 essentially the same manner as, and can be selected from those types of applicator systems set
3 forth previously. A particularly preferred representative additive applicator 70, and drive system
4 therefor, is described previously with reference to Figure 23. The additive material 73 most
5 preferably also is applied to predetermined locations on what is considered to be the inside
6 surface 88 of the paper web 55.

7 After the additive material 73 has been applied to the paper web 55, the web can be
8 exposed to a sensor or detector 95 for an inspection system (not shown). Preferably, the detector
9 95 is positioned so as to receive information concerning the paper web 55 immediately after
10 additive material 73 has been applied to that paper web. A capacitance type of detector (e.g.,
11 that can be used to detect the presence of water of the coating formulation) is preferred; and one
12 representative type of capacitance detector is available as DMT 20 from Lion Precision.
13 Typically, the detector 95 is used in conjunction with the certain inspection systems of the type
14 described previously with reference to Figure 15. For example, capacitance detector is available
15 as DMT 20 from Lion Precision can be connected to a high speed data acquisition board (e.g., a
16 PXI-1002 unit available from National Instrument); data from the detector is appropriately
17 analyzed using the data acquisition board, and information regarding specifications of the pattern
18 applied to the continuous paper web is generated; an output signal is sent from the data
19 acquisition board to a PLC, informing the operator that the paper web so treated is out of
20 specification; and the operator then can stop the operation of the machine or take steps to rectify
21 the cause of the problem associated with production of wrapping material that is out of
22 specification tolerance. Alternative sensors, detectors and inspection system components and
23 description of inspection system technologies and operation are set forth in U.S. Patent Nos.
24 4,845,374 to White et al.; 5,966,218 to Bokelman et al.; 6,020,969 to Struckhoff et al. and
25 6,198,537 to Bokelman et al.

26 Additionally, after the additive material 73 has been applied to the paper web 55 (i.e.,
27 downstream from the applicator apparatus 70), the web can be passed through an optional,
28 though highly preferred, heating/cooling control device 280, or other suitable means for
29 controlling heat to which the paper web is subjected. The control device 280 can be supported
30 by a frame 2105, or the frame 205 that supports the unwind unit 245 and applicator apparatus 70
31 can be adapted to support the control device 280. The control device 280 can be used to alter the

1 heat to which the paper web 55 and additive material is subjected (e.g., by raising or lowering the
2 temperature). For example, the control device can be a heating or drying device adapted to assist
3 in the removal of solvent (e.g., moisture) from the additive material 73 that has been applied to
4 the paper web 55. Alternatively, for example, the heating/cooling control device can be a
5 cooling device adapted to assist in the hardening melted additive material 73 that has been
6 applied to the paper web 55 using a heated additive applicator system 70. Typically, the
7 heating/cooling control device 280 has a tunnel-type configuration through which the paper web
8 55 is passed (through an inlet end 282 and out an outlet end 283); and during the time that the
9 paper web is present within that tunnel region, the paper web is subjected to heating supplied
10 using infrared convection or radiant heating devices, or cooling supplied using refrigerant-type,
11 solid carbon dioxide-type or liquid nitrogen-type cooling devices.

12 The size of the heating/cooling device 280 can vary. Exemplary heating/cooling devices
13 280 have lengths of about 2 feet to about 10 feet, with lengths of about 3 feet to about 8 feet
14 being typical, and lengths of about 4 feet to about 7 feet being desirable. The distance that the
15 paper web 55 travels through the heating/cooling device 280 (i.e., the length of travel through
16 that device) can vary. For example, the paper web 55 can be routed back and forth within the
17 heating/cooling device 280 using a suitably adapted roller system configuration (not shown).
18 Representative heating/cooling control devices are described previously with reference to Figure
19 2. Radiant-type drying systems (e.g., microwave-type drying systems) are preferred.

20 The paper web 55 exits the temperature control device 280 and is advanced to a rewind
21 unit 2120. As such, the paper web 55 is wrapped on a core 2125, thereby forming a second
22 bobbin 2100. Optionally, a suitable detector 2130 can be positioned so as to provide for
23 inspection of the paper web 55 after that paper web exits the temperature control device 280. For
24 example, the detector 2130 can be used to detect breaks in the paper web 55, and hence initiate
25 shut down of the operation of the supply machine 200. A representative paper break detector is
26 available as Model No. T18SP6FF50Q from Banner Engineering Inc. The selection and use of
27 other types of detection systems will be readily apparent to those skilled in the art of design and
28 operation of cigarette making machines. Direction of the paper web 55 is provided by suitably
29 aligned series of idler rollers 312, 314, 316 (or guideposts, turning bars, air bars, or other suitable
30 means for directing the paper web throughout the supply machine 200). Suitable pathways for
31 travel of the paper web 55 can be provided by suitably designed tracks or tunnels (not shown).

1 As such, there is provided a way to direct the paper web to the rewind unit 2120, or to an
2 otherwise suitable location. The system also can include components capable of allowing for
3 automatic bobbin changing and splicing functions. It is highly preferred that the wrapping
4 material is wound on the second bobbin 2100 such that when the bobbin is mounted on a
5 conventional type of automated cigarette making machine (not shown), the surface of the
6 wrapping material having additive material applied thereto provides the inner face of the
7 smokable rod so manufactured.

8 The additive applicator 70 used in conjunction with the supply machine 200 most
9 preferably is driven by a servo drive control system (not shown) or other suitable control means.
10 Suitable servo-based systems and the operation thereof are described in greater detail
11 hereinbefore with reference to Figure 1. An exemplary servo system for operating the applicator
12 apparatus 70 is available from Bosch Rexroth. The speed of operation of the additive applicator
13 70 and speed of operation of the supply unit 220 can be controlled relative to one another. Thus,
14 the operation of the applicator apparatus 70 relative to the speed of travel of the continuous paper
15 web 55 can be controlled relative to one another. As such, the positioning of the additive
16 material 73 at desired locations on the paper web 55 can be controlled. In addition, the applicator
17 apparatus 70 can be configured to apply a desired pattern of additive material to the continuous
18 strip of paper web. For example, the applicator apparatus can be configured so that it is possible
19 to consistently produce a wrapping material having additive material applied thereto and
20 positioned thereon, such that the wrapping material so produced can be used to manufacture a
21 plurality of cigarette rods, each rod possessing at least two identical bands (e.g., each having a
22 width of about 5 mm to about 7 mm), and the spacing between the bands, measured from the
23 inside adjacent edges of the bands, is no less than 15 mm and no greater than 25 mm.

24 The rewind unit 2120 also can utilize the types of components used for constructing the
25 unwind systems of conventional automated cigarette making machines, and that rewind unit can
26 incorporate appropriate electrical motor controls and a servo system. Typically, the rewind
27 spindle is driven by a motor, such as Baldor Industrial Motor, Catalogue No. CDP3330 from
28 Baldor Electric Co. Such a drive, such as a direct current drive, is turned by a reference voltage
29 (e.g., about 0 to about 10 volts); and when the drive is operated, an encoder coupled with the
30 drive is operated. A representative suitable encoder is available as ID No. 295466-12 from
31 Heidenhain. The output of the encoder is fed to a servo drive (e.g., and Indramat Model No.

1 MKD025B-144-GP0-KN from Bosch Rexroth), which in turn drives relevant components (e.g.,
2 the application wheel and supply rollers) of the applicator 70. The speed of operation of the
3 rewind unit 2120 can be controlled relative to those speeds of operation of the additive applicator
4 70 and the supply unit 220. The system also can include components, such as an automatic
5 bobbin changer/splicer and/or an automatic rewind bobbin changer.

6 When sufficient processed paper web 55 has been wound onto the rewind core 2125, the
7 continuous strip is cut, and the resulting full bobbin 2100 is removed from the supply machine
8 200. Selection of additive material 73 and effective treatment of the wrapping material 55 after
9 application of that additive material thereto can ensure that the wrapping material wound onto
10 the second bobbin 2100 does not have a propensity stick to itself, and hence, the wrapping
11 material can be readily removed from that bobbin.

12 Referring to Fig. 30, there is shown another representative alternate embodiment of
13 wrapping material supply machine 200. Such a machine 200 possesses spindle assembly units
14 220, 228, a splicing system 232, an applicator apparatus 70, a detector 95, a heating/cooling
15 control device 280, and a frame 205 that supports the foregoing. The machine 200 possesses an
16 ability to apply a desired pattern of additive material (not shown) to a continuous strip of paper
17 web (not shown) supplied from a bobbin (not shown). Such a machine 200 can be used to apply
18 an additive material in the form of a coating formulation (e.g., a water-based starch-based
19 formulation) to a continuous paper web. Various representative types of applicator systems 70
20 are set forth previously, and a particularly preferred type of applicator apparatus described
21 hereinbefore with reference to Fig. 23. The continuous paper web having a pattern of additive
22 material applied thereto can be passed through the entrance region 282 of the heating/cooling
23 control device 280, and then exit through the exit region 283 of that control device 280. Then,
24 the wrapping material can be directed to a cigarette making machine (not shown) in situations in
25 which the machine 200 is used in an on-line manner, or the wrapping material can be directed to
26 a rewind unit (not shown) in order to provide a roll of treated wrapping material (e.g., in the form
27 of a bobbin), in situations in which the machine 200 is used in an off-line manner. The frame
28 205 can be modified to support the rewind unit (not shown), for circumstances in which the
29 supply machine 200 is used in an off-line manner. The applicator apparatus 70 can be
30 configured to apply a desired pattern of additive material to the continuous strip of paper web.
31 For example, the applicator apparatus can be configured so that it is possible to consistently

1 produce a wrapping material having additive material applied thereto and positioned thereon,
2 such that the wrapping material so produced can be used to manufacture a plurality of cigarette
3 rods, each rod possessing at least two identical bands (e.g., each having a width of about 5 mm to
4 about 7 mm), and the spacing between the bands, measured from the inside adjacent edges of the
5 bands, is no less than 15 mm and no greater than 25 mm.

6 If desired, the off-line type of system can be operated so as to provide one processed
7 bobbin at a time. Alternatively, the off-line type of system can be employed by adapting that
8 system so as to provide a processed master roll, which then can be slit to provide a plurality of
9 bobbins each of the desired width. Alternatively, the off-line system can be suitably adapted to
10 simultaneously produce several processed bobbins at a time. For example, the system can be
11 modified to handle several bobbins by employing a long unwind spindle unit having
12 appropriately positioned spacers, multiple appropriately positioned paper guides, multiple
13 applicator units, multiple microwave wave guides coupled with a large microwave generator,
14 multiple detection units, and a long rewind spindle unit having appropriately positioned spacers.
15 Unwind and rewind equipment can be obtained from commercial sources, and can be suitably
16 modified, if desired. Manners and methods for operating bobbin unwind and rewind units will
17 be readily apparent to those having skill in the art of paper conversion.

18 The various components, systems and methods can be employed individually, or in
19 various combinations with one another. In one regard, a cigarette making machine assembly can
20 incorporate an on-line additive application system for a paper web, a modified finger rail
21 assembly and/or a modified garniture entrance cone, a registration system, an inspection system,
22 and heating/cooling control system, each of which are of the type that have been described as
23 various aspects of the present invention. In another regard, for example, the on-line additive
24 application systems can be incorporated into cigarette making machine assemblies without any
25 or all of those other components that have been described as various aspects of the present
26 invention. In another regard, for example, the modified finger rail assemblies and/or the
27 modified garniture entrance cones can be incorporated into cigarette making machine assemblies
28 that do not possess any or all of those other components or features that have been described as
29 various aspects of the present invention. In addition, for example, cigarette making machine
30 assemblies possessing on-line application systems, modified finger rail assemblies and/or
31 modified garniture entrance cones and heating/cooling control systems of the types of the present

1 invention can be employed without using registration systems and/or inspection systems.
2 Likewise, for example, cigarette making machine assemblies possessing registration systems
3 and/or inspection systems of the types of the present inventions can be employed without using
4 those modified finger rail assemblies, modified garniture entrance cones and/or heating/cooling
5 control systems that have been described as various aspects of the present invention.

6 The various aspects of the present invention, whether employed individually or in some
7 combination, offer several advantages and improvements to conventional systems and methods
8 for cigarette manufacture. The present invention allows a cigarette manufacturer to apply
9 predetermined and discrete amounts of an additive material to a continuous advancing strip of a
10 paper web at desired locations on that paper web, during the manufacture of a continuous
11 cigarette rod using conventional types of cigarette making equipment and methodologies. Of
12 particular interest are bands of additive material that are positioned perpendicularly to the
13 longitudinal axis of the paper web, and those bands can be positioned so as to extend across less
14 than the total width of that paper web. As such, the location of additive material can be
15 controlled so as to not be located in the lap zone of the continuous cigarette rod (e.g., where the
16 side seam adhesive is applied). For the production of certain preferred banded cigarettes, the
17 spaced bands are applied on the wrapping material so that the bands virtually entirely encircle
18 the formed smokable column of each cigarette, while the inner surface of that portion of the
19 wrapping material that provides the overlapping lap zone of the side seam region does not
20 necessarily have additive material applied thereto. Thus, for example, a continuous paper web
21 having a width of about 27 mm and used to provide a cigarette rod having a circumference of
22 about 24.5 mm (i.e., such that the lap zone has a width of about 2.5 mm) can have a band applied
23 to that web such that the band is not located within the lap zone where side seam adhesive is
24 applied; and as such, such a band can have a transversely extending length of about 22 mm to
25 about 24.5 mm, but most preferably about 24.5 mm. The present invention allows a cigarette
26 manufacturer to apply to paper webs additive formulations that have a wide range of chemical
27 and physical properties, and that are provided for application in a wide variety of forms (e.g., a
28 wide range of viscosities). The finger rail modifications, the garniture entrance cone
29 modifications and the heating/cooling control systems of the present invention provide a
30 manufacturer of cigarettes an efficient and effective way to produce cigarettes having additive
31 material applied to the wrapping materials of those cigarette rods in an on-line fashion, during

1 the manufacture of those cigarette rods. That is, the present invention advantageously provides a
2 means for retaining an additive material on a paper web and preventing transfer of the additive
3 material to the surfaces of various components of a cigarette making machine. In addition, the
4 present invention allows a manufacturer of cigarettes to apply additive materials to paper webs
5 without adversely affecting the physical properties and integrity of that paper web to any
6 significant degree. Registration of patterns (e.g., bands) applied to the paper wrapping materials
7 of tobacco rods promotes the ability of cigarette manufacturers to provide consistent quality
8 cigarette rods, and the ability to control the properties of cigarettes through on-line production
9 techniques offers advantages over cigarettes that are manufactured using pre-printed paper
10 wrapping materials. The present invention also provides a manufacturer of cigarettes with the
11 ability to ensure the production of high quality cigarettes with applied patterns registered in the
12 desired locations of those cigarettes.

13 Certain preferred paper wrapping materials used in carrying out the present invention are
14 useful for the manufacture of cigarettes designed to exhibit reduced ignition propensity. That is,
15 cigarettes incorporating certain wrapping materials, when placed on a flammable substrate, tend
16 to self extinguish before burning that substrate. Of particular interest are those cigarettes
17 possessing tobacco rods manufactured using appropriate wrapping materials possessing bands
18 composed of appropriate amounts of appropriate components so as to have the ability to meet
19 certain cigarette extinction criteria. Also, of particular interest are those cigarettes possessing
20 tobacco rods manufactured using appropriate wrapping materials designed to possess appropriate
21 numbers of bands having appropriate features and positioned at appropriate locations, so as to
22 have the ability to meet certain cigarette extinction design criteria.

23 The paper wrapping material that is further processed to provide the patterned wrapping
24 material can have a wide range of compositions and properties. The selection of a particular
25 wrapping material will be readily apparent to those skilled in the art of cigarette design and
26 manufacture. Typical paper wrapping materials are manufactured from fibrous materials, and
27 optional filler materials, to form so-called "base sheets." Wrapping materials of the present
28 invention can be manufactured without significant modifications to the production techniques or
29 processing equipment used to manufacture those wrapping materials.

30 Typical wrapping material base sheets suitable for use as the circumscribing wrappers of
31 tobacco rods for cigarettes have basis weights that can vary. Typical dry basis weights of base

1 sheets are at least about 15 g/m², and frequently are at least about 20 g/m²; while typical dry
2 basis weights do not exceed about 80 g/m², and frequently do not exceed about 60 g/m². Many
3 preferred wrapping material base sheets have basis weights of less than 50 g/m², and even less
4 than 40 g/m². Certain preferred paper wrapping material base sheets have basis weights between
5 about 20 g/m² and about 30 g/m².

6 Typical wrapping material base sheets suitable for use as the circumscribing wrappers of
7 tobacco rods for cigarettes have inherent porosities that can vary. Typical base sheets have
8 inherent porosities that are at least about 5 CORESTA units, usually are at least about 10
9 CORESTA units, often are at least about 15 CORESTA units, and frequently are at least about
10 20 CORESTA units. Typical base sheets have inherent porosities that are less than about 200
11 CORESTA units, usually are less than about 150 CORESTA units, often are less than about 85
12 CORESTA units, and frequently are less than about 70 CORESTA units. A CORESTA unit is a
13 measure of the linear air velocity that passes through a 1 cm² area of wrapping material at a
14 constant pressure of 1 centibar. See, CORESTA Publication ISO/TC0126/SC I N159E (1986).
15 The term "inherent porosity" refers to the porosity of that wrapping material itself to the flow of
16 air. A particularly preferred paper wrapping material base sheet is composed of wood pulp and
17 calcium carbonate, and exhibits an inherent porosity of about 20 to about 50 CORESTA units.

18 Typical paper wrapping material base sheets suitable for use as the circumscribing
19 wrappers of tobacco rods for cigarettes incorporate at least one type of fibrous material, and can
20 incorporate at least one filler material, in amounts that can vary. Typical base sheets include
21 about 55 to about 100, often about 65 to about 95, and frequently about 70 to about 90 percent
22 fibrous material (which most preferably is a cellulosic material); and about 0 to about 45, often
23 about 5 to about 35, and frequently about 10 to about 30 percent filler material (which most
24 preferably is an inorganic material); based on the dry weight of that base sheet.

25 The wrapping material incorporates a fibrous material. The fibrous material can vary.
26 Most preferably, the fibrous material is a cellulosic material, and the cellulosic material can be a
27 lignocellulosic material. Exemplary cellulosic materials include flax fibers, hardwood pulp,
28 softwood pulp, hemp fibers, esparto fibers, kenaf fibers, jute fibers and sisal fibers. Mixtures of
29 two or more types of cellulosic materials can be employed. For example, wrapping materials can
30 incorporate mixtures of flax fibers and wood pulp. The fibers can be bleached or unbleached.
31 Other fibrous materials that can be incorporated within wrapping materials include microfibers

1 materials and fibrous synthetic cellulosic materials. See, for example, U.S. Patent Nos.
2 4,779,631 to Durocher and 5,849,153 to Ishino. Representative fibrous materials, and methods
3 for making wrapping materials therefrom, are set forth in U.S. Patent Nos. 2,754,207 to Schur et
4 al; and 5,474,095 to Allen et al.; and PCT WO 01/48318.

5 The wrapping material normally incorporates a filler material. Certain types of filler
6 materials are set forth in PCT WO 03/043450. Preferably, the filler material has the form of
7 essentially water insoluble particles. Additionally, the filler material normally incorporates
8 inorganic components. Filler materials incorporating calcium salts are particularly preferred.
9 One exemplary filler material has the form of calcium carbonate, and the calcium carbonate most
10 preferably is used in particulate form. See, for example, U.S. Patent Nos. 4,805,644 to Hampl;
11 5,161,551 to Sanders; and 5,263,500 to Baldwin et al.; and PCT WO 01/48,316. Other filler
12 materials include agglomerated calcium carbonate particles, calcium tartrate particles,
13 magnesium oxide particles, magnesium hydroxide gels; magnesium carbonate-type materials,
14 clays, diatomaceous earth materials, titanium dioxide particles, gamma alumina materials and
15 calcium sulfate particles. See, for example, U.S. Patent Nos. 3,049,449 to Allegrini; 4,108,151
16 to Martin; 4,231,377 to Cline; 4,450,847 to Owens; 4,779,631 to Durocher; 4,915,118 to
17 Kaufman; 5,092,306 to Bokelman; 5,109,876 to Hayden; 5,699,811 to Paine; 5,927,288 to
18 Bensalem; 5,979,461 to Bensalem; and 6,138,684 to Yamazaki; and European Patent
19 Application 357359. Certain filler-type materials that can be incorporated into the wrapping
20 materials can have fibrous forms. For example, components of the filler material can include
21 materials such as glass fibers, ceramic fibers, carbon fibers and calcium sulfate fibers. See, for
22 example, U.S. Patent Nos. 2,998,012 to Lamm; 4,433,679 to Cline; and 5,103,844 to Hayden et
23 al.; PCT WO 01/41590; and European Patent Application 1,084,629. Mixtures of filler materials
24 can be used. For example, filler material compositions can incorporate mixtures of calcium
25 carbonate particles and precipitated magnesium hydroxide gel, mixtures of calcium carbonate
26 particles and calcium sulfate fibers, or mixtures of calcium carbonate particles and magnesium
27 carbonate particles.

28 There are various ways by which the various additive components can be added to, or
29 otherwise incorporated into, the base sheet. Certain additives can be incorporated into the
30 wrapping material as part of the paper manufacturing process associated with the production of
31 that wrapping material. Alternatively, additives can be incorporated into the wrapping material

1 using size press techniques, spraying techniques, printing techniques, or the like. Such
2 techniques, known as "off-line" techniques, are used to apply additives to wrapping materials
3 after those wrapping materials have been manufactured. Various additives can be added to, or
4 otherwise incorporated into, the wrapping material simultaneously or at different stages during or
5 after the paper manufacturing process.

6 The base sheets can be treated further, and those base sheets can be treated so as to impart
7 a change to the overall physical characteristics thereof and/or so as to introduce a change in the
8 overall chemical compositions thereof. For example, the base sheet can be electrostatically
9 perforated. See, for example, U.S. Patent No. 4,924,888 to Perfetti et al. The base sheet also can
10 be embossed, for example, in order to provide texture to major surface thereof. Additives can be
11 incorporated into the wrapping material for a variety of reasons. Representative additives, and
12 methods for incorporating those additives to wrapping materials, are set forth in U.S. Patent No.
13 5,220,930 to Gentry, which is incorporated herein by reference. See, also, U.S. Patent No.
14 5,168,884 to Baldwin et al. Certain components, such as alkali metal salts, can act a burn control
15 additives. Representative salts include alkali metal succinates, citrates, acetates, malates,
16 carbonates, chlorides, tartrates, propionates, nitrates and glycolates; including sodium succinate,
17 potassium succinate, sodium citrate, potassium citrate, sodium acetate, potassium acetate,
18 sodium malate, potassium malate, sodium carbonate, potassium carbonate, sodium chloride,
19 potassium chloride, sodium tartrate, potassium tartrate, sodium propionate, potassium
20 propionate, sodium nitrate, potassium nitrate, sodium glycolate and potassium glycolate; and
21 other salts such as monoammonium phosphate. Certain alkali earth metal salts also can be used.
22 See, for example, U.S. Patent Nos. 2,580,568 to Matthews; 4,461,311 to Matthews; 4,622,983 to
23 Matthews; 4,941,485 to Perfetti et al.; 4,998,541 to Perfetti et al.; and PCT WO 01/08514; which
24 are incorporated herein by reference. Certain components, such as metal citrates, can act as ash
25 conditioners or ash sealers. See, for example, European Patent Application 1,084,630. Other
26 representative components include organic and inorganic acids, such as malic, levulinic, boric
27 and lactic acids. See, for example, U.S. Patent No. 4,230,131 to Simon. Other representative
28 components include catalytic materials. See, for example, U.S. Patent No. 2,755,207 to
29 Frankenburg. Typically, the amount of chemical additive does not exceed about 3 percent, often
30 does not exceed about 2 percent, and usually does not exceed about 1 percent, based on the dry
31 weight of the wrapping material to which the chemical additive is applied. For certain wrapping

1 materials, the amount of certain additive salts, such as burn chemicals such as potassium citrate
2 and monoammonium phosphate, preferably are in the range of about 0.5 to about 0.8 percent,
3 based on the dry weight of the wrapping material to which those additive salts are applied.
4 Relatively high levels of additive salts can be used on certain types of wrapping materials printed
5 with printed regions that are very effective at causing extinction of cigarettes manufactured from
6 those wrapping materials. Exemplary flax-containing cigarette paper wrapping materials having
7 relatively high levels of chemical additives have been available as Grade Names 512, 525, 527,
8 540, 605 and 664 from Schweitzer-Mauduit International. Exemplary wood pulp-containing
9 cigarette paper wrapping materials having relatively high levels of chemical additives have been
10 available as Grade Names 406 and 419 from Schweitzer-Mauduit International.

11 Flavoring agents and/or flavor and aroma precursors (e.g., vanillin glucoside and/or ethyl
12 vanillin glucoside) also can be incorporated into the paper wrapping material. See, for example,
13 U.S. Patent Nos. 4,804,002 to Herron; and 4,941,486 to Dube et al. Flavoring agents also can be
14 printed onto cigarette papers. See, for example, the types of flavoring agents used in cigarette
15 manufacture that are set forth in Gutcho, *Tobacco Flavoring Substances and Methods*, Noyes
16 Data Corp. (1972) and Leffingwell et al., *Tobacco Flavoring for Smoking Products* (1972).

17 Films can be applied to the paper. See, for example, 4,889,145 to Adams; U.S. Patent
18 No. 5,060,675 to Milford et al., and PCT WO 02/43513 and PCT WO 02/055294. Catalytic
19 materials can be incorporated into the paper. See, for example, PCT WO 02/435134 and US
20 Patent Application Serial No. 10/342,618, filed January 15, 2003.

21 Typical paper wrapping materials that can be used in carrying out the present invention
22 are manufactured under specifications directed toward the production of a wrapping material
23 having an overall generally consistent composition and physical parameters. For those types of
24 wrapping materials, the composition and parameters thereof preferably are consistent when
25 considered over regions of each of the major surfaces of those materials. However, typical
26 wrapping materials tend to have a "two-sided" nature, and thus, there can be changes in the
27 composition and certain physical parameters of those materials from one major surface to the
28 other.

29 Though less preferred, the wrapping material can be manufactured using a paper making
30 process adapted to provide a base web comprising multiple layers of cellulosic material. See,
31 U.S. Patent No. 5,143,098 to Rogers et al.

1 Much less preferred paper wrapping materials can have compositions and/or properties
2 that differ over different regions of each of their major surfaces. The wrapping material can have
3 regions of increased or decreased porosity provided by control of the composition of that
4 material, such as by controlling the amount or type of the filler. The wrapping material can have
5 regions of increased or decreased air permeability provided by embossing or perforating that
6 material. See, for example, U.S. Patent No. 4,945,932 to Mentzel et al. The wrapping material
7 can have regions (e.g., predetermined regions, such as bands) treated with additives, such as
8 certain of the aforementioned salts. However, wrapping materials having a patterned nature are
9 not necessary when various aspects of the present invention are used to apply patterns to those
10 wrapping materials using on-line pattern application techniques.

11 Paper wrapping materials suitable for use in carrying out the present invention are
12 commercially available. Representative cigarette paper wrapping materials have been available
13 as Ref. Nos. 419, 454, 456, 460 and 473 Ecusta Corp.; Ref. Nos. Velin 413, Velin 430, VE 825
14 C20, VE 825 C30, VE 825 C45, VE 826 C24, VE 826 C30 and 856 DL from Miquel; Tercig
15 LK18, Tercig LK24, Tercig LK38, Tercig LK46 and Tercig LK60 from Tervakoski; and Velin
16 Beige 34, Velin Beige 46, Velin Beige 60, and Ref. Nos. 454 DL, 454 LV, 553 and 556 from
17 Wattens. Other representative cigarette paper wrapping materials are available as 38 CORESTA
18 unit Printed Diagonal Lines, 46 CORESTA unit Printed Diagonal Lines, 60 CORESTA unit
19 Printed Diagonal Lines, 38 CORESTA unit Longitudinal Verge Lines, 46 CORESTA unit
20 Longitudinal Verge Lines, 60 CORESTA unit Longitudinal Verge Lines, 46 CORESTA unit
21 Beige Velin and 60 CORESTA unit Beige Velin from Trierenberg Holding in Austria.
22 Exemplary flax-containing cigarette paper wrapping materials have been available as Grade
23 Names 105, 114, 116, 119, 170, 178, 514, 523, 536, 520, 550, 557, 584, 595, 603, 609, 615 and
24 668 from Schweitzer-Mauduit International. Exemplary wood pulp-containing cigarette paper
25 wrapping materials have been available as Grade Names 404, 416, 422, 453, 454, 456, 465, 466
26 and 468 from Schweitzer-Mauduit International.

27 Coating formulations or additive materials typically are applied to wrapping materials
28 that are supplied from rolls, and most preferably, from bobbins. The amount of wrapping
29 material on a bobbin can vary, but the length of continuous strip of wrapping material on a
30 bobbin typically is more than about 6,000 meters; and generally, the length of continuous strip of
31 wrapping material on a bobbin typically is less than about 7,000 meters. The width of the

1 wrapping material can vary, depending upon factors such as the circumference of the smokable
2 rod that is manufactured and the width of the overlap region zone that provides for the sideseam.
3 Typically, the width of a representative continuous strip of wrapping material is about 24 mm to
4 about 30 mm.

5 The composition of the additive material or coating formulation can vary. Generally, the
6 composition of the coating is determined by the ingredients of the coating formulation.
7 Preferably, the coating formulation has an overall composition, and is applied in a manner and in
8 an amount, such that the physical integrity of the wrapping material is not adversely affected
9 when the coating formulation is applied to selected regions of the wrapping material. It also is
10 desirable that components of the coating formulation not introduce undesirable sensory
11 characteristics to the smoke generated by a smoke article incorporating a wrapping material
12 treated with that coating formulation. Thus, suitable combinations of various components can
13 act to reduce the effect of coatings on sensory characteristics of smoke generated by the smoking
14 article during use. Preferred coatings provide desirable physical characteristics to cigarettes
15 manufactured from wrapping materials incorporating those coatings. Preferred coatings also can
16 be considered to be adhesives, as it is desirable for those coatings to remain in intimate contact
17 with (e.g., to adhere to or otherwise remain secured to) desired locations on the wrapping
18 material.

19 Examples of certain types of coating formulations and representative types of
20 components thereof are set forth in U.S. Patent Nos. 4,889,145 to Adams; and 5,060,675 to
21 Milford et al.; U.S. Patent Applications 2003/0131860 to Ashcraft et al.; 2003/0145869 to Kitao
22 et al. and 2003/0150466 to Kitao et al.; and U.S. Patent Application Serial Nos. 09/892,834, filed
23 June 27, 2001; 10/324,418, filed December 20, 2002; 10/440,290, filed May 16, 2003 and
24 10/645,996, filed August 22, 2003; PCT WO 02/043513; PCT WO 02/055294; and European
25 Patent Application 1,234,514. Other coating formulations are described herein.

26 The coating formulation most preferably includes a film-forming agent. The film-
27 forming agent most preferably is a polymeric material or resin. Exemplary film-forming agents
28 include alginates (e.g., sodium alginate or ammonium alginate, including those alginates
29 available as Kelcosol from Kelco), pectins (e.g., including those available as TIC Pretested HM
30 from TIC Gums), derivatives of cellulose (e.g., carboxymethylcellulose including the Aqualon
31 sodium carboxymethylcellulose CMC from Hercules Incorporated, and other polymeric

1 materials such as hydroxypropylcellulose and hydroxyethylcellulose), ethylene vinyl acetate
2 copolymers, guar gum (e.g., including Type M, Type MM, Type MM high viscosity from
3 Frutarom; and Ticagel from TIC Gums), xanthan gum (e.g., including Keltrol from Kelco),
4 starch (e.g., corn starch and rice starch), modified starch (e.g., dextrin, oxidized tapioca starch
5 and oxidized corn starch), polyvinyl acetate and polyvinyl alcohol. Suitable combinations of
6 various film-forming agents also can be employed. Exemplary blends include water-based
7 blends of ethylene vinyl acetate copolymer emulsion and polyvinyl alcohol. Other exemplary
8 blends are water-based blends provided by mixing starches or modified starches with emulsion
9 polymers or copolymers.

10 The solvent or liquid carrier for the coating formulation can vary. The solvent can be a
11 liquid having an aqueous character, and can include relatively pure water. An aqueous liquid is a
12 suitable solvent or carrier for film-forming agents such as water-based emulsions, starch-based
13 materials, sodium carboxymethylcellulose, ammonium alginate, guar gum, xanthan gum, pectins,
14 polyvinyl alcohol and hydroxyethylcellulose. Starch-based materials are film-forming agents
15 that are composed of starch or components derived from starch. It is preferred that the solvent
16 not be a non-aqueous solvent, such as ethanol, *n*-propyl alcohol, *iso*-propyl alcohol, ethyl acetate,
17 *n*-propyl acetate, *iso*-propyl acetate, toluene, and the like. Formulations that incorporate solvents
18 in amounts and forms such that those solvents do not adversely affect the quality of the wrapping
19 material (e.g., by causing swelling of the fibers of the wrapping material, by causing puckering
20 of the wrapping material, or by causing wrinkling of the wrapping material) are particularly
21 preferred.

22 Generally, the selection of solvent depends upon the nature of the film-forming
23 polymeric material, and the particular polymeric material that is selected readily dissolves (i.e., is
24 soluble) or is highly dispersible in a highly preferred solvent. Although not all components of
25 the coating formulation are necessarily soluble in the liquid carrier, it is most preferable that the
26 film-forming polymeric material be soluble (or at least highly dispersible) in that liquid. By
27 "soluble" in referring to the components of the coating formulation with respect to the liquid
28 solvent is meant that the components for a thermodynamically stable mixture when combined
29 with the solvent, have a significant ability to dissolve in that solvent, and do not form precipitates
30 to any significant degree when present in that solvent. Suitable polymeric materials, such as

1 starch-based materials, can be processed within aqueous liquids to produce formulations that can
2 be considered to be "pastes."

3 The coating formulation also can include a filler material. Exemplary filler materials can
4 be the essentially water insoluble types of filler materials previously described. Preferred filler
5 materials have a finely divided (e.g., particulate) form. Typical fillers are those that have particle
6 sizes that are less than about 3 microns in diameter. Typical particle sizes of suitable fillers
7 range from about 0.3 micron to 2 microns in diameter. The filler materials can have a variety of
8 shapes. Exemplary filler materials are those that are composed of inorganic materials including
9 metal particles and filings, calcium carbonate (e.g., precipitated-type fillers, including those
10 having a prismatic form), calcium phosphate, clays (e.g., attapulgite clay), talc, aluminum oxide,
11 mica, magnesium oxide, calcium sulfate, magnesium carbonate, magnesium hydroxide,
12 aluminum oxide and titanium dioxide. See, for example, the types of filler materials set forth in
13 U.S. Patent No. 5,878,753 to Peterson et al. Representative calcium carbonate fillers are those
14 available as Albacar PCC, Albafil PCC, Albaglos PCC, Opacarb PCC, Jetcoat PCC and
15 Calopake F PCC from Specialty Minerals, Inc. Prismatic forms of calcium carbonate are
16 especially preferred. Exemplary filler materials also can be composed of organic materials
17 including starches, modified starches and flours (e.g., rice flour), particles of polyvinyl alcohol,
18 particles of tobacco (e.g., tobacco dust), extracts of tobacco (e.g., spray dried tobacco extracts),
19 and other like materials. The filler material also can be fibrous cellulosic materials. See, for
20 example, U.S. Patent No. 5,417,228 to Baldwin et al. Although less preferred, alternate fillers
21 can include carbon-based materials (e.g., graphite-type materials, carbon fiber materials and
22 ceramics), metallic materials (e.g., particles of iron), and the like. The filler material also can be
23 a water soluble salt (e.g., potassium chloride, sodium chloride, potassium citrate, sodium citrate,
24 calcium chloride or magnesium chloride). Other exemplary water soluble salts are those various
25 types of salts that are set forth hereinbefore as appropriate components of wrapping materials for
26 smokable rods. Filler materials are used to provide desirable properties to the printed
27 formulation, enhance wet coating hold-out, reduce the amount of water present in the
28 formulation, increase the weight and solids content of the formulation, decrease drying
29 requirements, facilitate drying process steps that involve the use of microwave dryers, and
30 decrease the propensity of tearing of the wrapping material to which the formulation is applied.

1 The coating formulations can incorporate other ingredients in addition to the
2 aforementioned coating materials. Those ingredients can be dispersed or suspended within the
3 coating formulation. Those other ingredients can be employed in order to provide specific
4 properties or characteristics to the wrapping material. Those ingredients can be preservatives
5 (e.g., potassium sorbate), humectants (e.g., ethylene glycol, propylene glycol, and derivatives
6 thereof), pigments, dyes, colorants, burn promoters and enhancers, burn retardants and inhibitors,
7 plasticers (e.g., dibutyl phthalate, polyethylene glycol, polypropylene glycol and triacetin), sizing
8 agents, syrups (e.g., high fructose corn syrup), flavoring agents (e.g., ethyl vanillin and
9 caryophyllene oxide), sugars (e.g., rhamnose), flavor precursors, components that provide a
10 desirable aroma or odor, deodorants, optical brighteners and other agents that can be used to
11 assist in inspecting the printed pattern, hydrate materials, such as metal hydrates (e.g., borax,
12 magnesium sulfate decahydrate, sodium silicate pentahydrate and sodium sulfate decahydrate),
13 oils, surfactants, defoaming agents, viscosity reducing agents (e.g., urea), acidic materials (e.g.,
14 inorganic acids, such as boric acid, and organic acids, such as citric acid), basic materials (e.g.,
15 alkali metal hydroxides), and the like. Certain of those ingredients are soluble in the solvent of
16 the coating formulation (e.g., certain salts, acids and bases are soluble in solvents such as water).
17 Certain of those ingredients are insoluble in the solvent of the coating formulation (e.g., particles
18 of metallic materials are insoluble in most of the solvents used for coating formulations). See,
19 for example, those types of components set forth in U.S. Patent Applications 2003/0131860 to
20 Ashcraft et al. Various types of suitable salts, including suitable water soluble salts, are set forth
21 in U.S. Patent Nos. 2,580,568 to Matthews; 4,461,311 to Matthews; 4,622,983 to Matthews;
22 4,941,485 to Perfetti et al.; 4,998,541 to Perfetti et al.; and PCT WO 01/08514.

23 The coating formulation typically has a liquid, syrup or paste form, and is applied as
24 such. Depending upon the actual ingredients that are combined with the solvent, the coating
25 formulation has the form of a solution, an emulsion (e.g., a water-based emulsion), or a liquid
26 having solid materials dispersed therein. Generally, the film-forming agent is dissolved or
27 dispersed in a suitable solvent to form the coating formulation. Certain other optional
28 ingredients also are dissolved, dispersed or suspended in that formulation. Additionally, optional
29 filler material also is dispersed within that formulation. Preferably, the filler material is
30 essentially insoluble and essentially chemically non-reactive with the solvent, at least at those
31 conditions at which the formulation is employed. Of particular interest are coating formulations

1 having the form of what can be considered to be pastes. Typically, a paste (i) is formed by
2 heating a mixture of water and a starch-based material sufficiently to hydrolyze the starch-based
3 material, (ii) has a flowable, plastic-type fluid form, (iii) exhibits adhesive properties, and hence
4 exhibits a tendency to maintain its position when applied to a substrate, and (iv) forms a
5 desirable film upon drying.

6 The relative amounts of the various components of the coating formulation can vary.
7 Typically, the coating formulation includes at least about 30 percent solvent, usually at least
8 about 40 percent solvent, and often at least about 50 percent solvent, based on the total weight of
9 that formulation. Typically, the amount of solvent within the coating formulation does not
10 exceed about 95 percent, usually does not exceed about 90 percent, and often does not exceed
11 about 85 percent, based on the total weight of that formulation. Most preferably, the coating
12 formulation includes at least about 0.5 percent film-forming agent, usually at least about 1
13 percent film-forming agent, and often at least about 2 percent film-forming agent, based on the
14 total weight of that formulation. Typically, the amount of film-forming agent within the coating
15 formulation does not exceed about 60 percent, usually does not exceed about 50 percent, and
16 often does not exceed about 40 percent, based on the total weight of that formulation. Typically,
17 the coating formulation includes at least about 3 percent of the optional filler material, usually at
18 least about 5 percent filler material, and often at least about 10 percent filler material, based on
19 the total weight of that formulation. Typically, the amount of optional filler material within the
20 coating formulation does not exceed about 35 percent, usually does not exceed about 30 percent,
21 and often does not exceed about 25 percent, based on the total weight of that formulation.

22 The amounts of other optional components of the coating formulation can vary. The
23 amount of plasticizer often ranges from about 0.5 percent to about 5 percent, preferably about 2
24 to about 3 percent, based on the total weight of the formulation. The amount of humectant often
25 ranges from about 1 percent to about 5 percent, preferably about 2 to about 3 percent, based on
26 the total weight of the formulation. The amount of wetting agent often ranges from about 0.5
27 percent to about 2 percent, preferably about 0.8 to about 1 percent, based on the total weight of
28 the formulation. The amount of preservative often ranges from about 0.01 percent to about 0.3
29 percent, preferably about 0.5 percent, based on the total weight of the formulation. The amount
30 of burn chemical often ranges from about 1 percent to about 15 percent, preferably about 5 to
31 about 10 percent, based on the total weight of the formulation. The amount of viscosity reducing

1 agent often ranges from about 1 percent to about 10 percent, preferably about 2 percent to about
2 6 percent, based on the total weight of the formulation. The amount of burn chemical often
3 ranges from about 1 percent to about 15 percent, preferably about 5 to about 10 percent, based on
4 the total weight of the formulation. The amount of metal hydrate often ranges from about 3
5 percent, usually at least about 5 percent, and often at least about 10 percent, based on the total
6 weight of that formulation; but the amount of metal hydrate usually does not exceed about 35
7 percent, often does not exceed about 30 percent, and frequently does not exceed about 25
8 percent, based on the total weight of that formulation.

9 Flavoring agents can be incorporated into the coating formulations. Preferably, the
10 flavoring agents exhibit sensory characteristics that can be described as having notes that are
11 sweet, woody, fruity, or some combination thereof. The flavoring agents preferably are
12 employed in amounts that depend upon their individual detection thresholds. Typically, the
13 flavoring agents are employed in sufficient amounts so as to mask or ameliorate the off-tastes
14 and malodors associated with burning paper. Combinations of flavoring agents (e.g., a flavor
15 package) can be employed in order to provide desired overall sensory characteristics to smoke
16 generated from the smoking articles incorporating those flavoring agents. Most preferably, those
17 flavoring agents are employed in amounts and manners so that the sensory characteristics of
18 those flavoring agents are hardly detectable; and those flavoring agents do not adversely affect
19 the overall sensory characteristics of smoking article into which they are incorporated. Preferred
20 flavoring agents can be incorporated into printing formulations, have low vapor pressures, do not
21 have a tendency to migrate or evaporate under normal ambient conditions, and are stable under
22 the processing conditions experienced by wrapping materials of the present invention.

23 Exemplary flavoring agents that provide sweet notes include ethyl vanillin, vanillin, heliotropin,
24 methylcyclopentenolone; and those flavoring agents typically are employed in amounts of 0.001
25 to about 0.01 percent, based on the total weight of the coating formulation into which they are
26 incorporated. An exemplary flavoring agent that provides woody notes includes caryophyllene
27 oxide; and that flavoring agent typically is employed in amounts of 0.2 to about 0.6 percent,
28 based on the total weight of the coating formulation into which it is incorporated. Exemplary
29 flavoring agents that provide fruity notes include ketones such as 4-hydroxyphenyl-2-butanone
30 and lactones such as *gamma*-dodecalactone; and those flavoring agents typically are employed in

1 amounts of 0.001 to about 0.1 percent, based on the total weight of the coating formulation into
2 which they are incorporated.

3 Certain additive materials can be applied to the wrapping material in the form of a
4 coating formulation that is in a so-called "solid polymer" form. That is, film-forming materials,
5 such as ethylene vinyl acetate copolymers and certain starches, can be mixed with other
6 components of the coating formation, and applied to the wrapping material without the necessity
7 of dissolving those film-forming materials in a suitable solvent. Typically, solid polymer coating
8 formulations are applied at elevated temperatures relative to ambient temperature; and the
9 viscosities of the film-forming materials of those heated coating formulations typically have an
10 extremely wide range of viscosities.

11 One suitable formulation for an additive material for a paper web incorporates a water-
12 based coating that is employed in liquid form, and that coating is an adhesive formulation of R. J.
13 Reynolds Tobacco Company used as a cigarette seam adhesive and designated as CS-1242. The
14 CS-1242 formulation is a water emulsion-based adhesive consisting of about 87 to about 88
15 weight percent ethylene vinyl acetate copolymer emulsion sold under the designation Resyn 32-
16 0272 by National Starch & Chemical Company, and about 12 to about 13 weight percent
17 adhesive concentrate stabilizer of R. J. Reynolds Tobacco Company known as AC-9. The AC-9
18 adhesive concentrate stabilizer consists of about 92 weight percent water and about 8 weight
19 percent polyvinyl alcohol resin available as Celvol 205 from Celanese Chemicals. Such a
20 formulation exhibits a viscosity of about 400 centipoise. If desired, the formulation can contain
21 dyes or pigments for aesthetic purposes or to facilitate automated inspection of paper wrapping
22 materials to which the formulation is applied. Such a formulation is particularly suitable for use
23 with an application system of the type described previously with reference to Figures 3 and 4.

24 Certain highly preferred formulations incorporate at least one type of starch-based
25 material. Typical formulations incorporate about 25 to about 65, generally about 35 to about 55,
26 weight percent water; about 30 to about 55, generally about 35 to about 50, weight percent
27 starch-based material; and about 0 to about 35 weight percent other components (e.g., such as the
28 types of additive components that have been described previously). For example, filler materials
29 can make up about 5 to about 30 weight percent of such a formulation; preservatives can make
30 up less than about 1 weight percent of such a formulation; and colorants can make up a very
31 small amount of the formulation. Typically, the solvent (e.g., water) content of a suitable

1 formulation can be at least about 35 and up to about 50 weight percent of the formulation, and
2 the starch-based material and other non-solvent components of the formulation can make up at
3 least about 50 and up to about 65 weight percent of the formulation. For certain formulations,
4 water comprises less than about 50 percent of the formulation. If desired, mixtures of starch-
5 based materials and emulsion polymers, or mixtures of starch-based materials and emulsion
6 copolymers, can be employed. An exemplary formulation can be provided by mixing a starch-
7 based material in water with a polyvinylalcohol-stabilized emulsion polymer or copolymer (e.g.,
8 ethylene vinyl acetate); or by mixing a starch-based material in water with a surfactant-stabilized
9 emulsion polymer or copolymer. For example, surfactant-stabilized ethylene vinyl acetate
10 copolymer emulsions, such as those having solids contents of about 70 to about 75 percent by
11 weight, can be incorporated within starch-based paste formulations in amounts of about 5 to
12 about 25 percent, based on the total weight of the formulation. As another example, dry addition
13 of low molecular weight polyvinylalcohol into either a surfactant-stabilized vinyl acetate
14 ethylene emulsion or a polyvinylalcohol-stabilized emulsion to produce an emulsion having a
15 solids content of about 50 to about 75 percent by weight, can be incorporated with starch-based
16 paste formulations in amounts of about 5 to about 25 percent, based on the total weight of the
17 formulation.

18 The type of starch-based material can vary. Exemplary starches include tapioca, waxy
19 maize, corn, potato, wheat, rice, and sago starches. Modified starches also can be employed.
20 Starch can be treated with acid to provide a thin boiling starch, treated with sodium hypochlorite
21 to provide an oxidized starch, treated with acid and roasted to provide a dextrin, polymerized to
22 provide a crosslinked specialty starch, or chemically substituted. Combinations of starches and
23 modified starches can be employed; and as such, suitable coating formulations can incorporate at
24 least two starch-based materials. Exemplary starch-based materials include materials
25 characterized as being derived from tapioca starch, as being derived from waxy maize starch, and
26 as being dextrans, See, for example, the trade booklet *Corn Starch*, Corn Industries Research
27 Foundation, Inc. (1955).

28 Typically, starches and/or modified starches are dispersed in water, and heated
29 sufficiently to cause the starch-based material to undergo hydration. A variety of methods can be
30 used to heat aqueous dispersions incorporating starch-based materials. Suitable starch-based
31 formulations usually are manufactured using batch-type of process, although jet cooking, and

1 other types of continuous cooking, also can be employed. Preferred methods for providing
2 starch-based paste types of materials of desirable stability and smoothness involve control of
3 temperature, heating time, agitation, cooling and cooling time. Processing of a mixture of
4 aqueous liquid and starch-based material provides a formulation that possesses the starch-based
5 component in a form that is capable of forming a type of film on the wrapping material to which
6 the formulation is applied. Typical starch-based pastes are shear sensitive, and hence are suitable
7 for application to a wrapping material using the types of equipment described hereinbefore; and
8 in addition, the gelling properties of starch-based pastes cause those formulations to form
9 desirable films on the surface regions of those wrapping materials.

10 A preferred method for cooking a starch-based formulation having the form of a paste
11 involves measuring the required amount of water (e.g., water at ambient temperature or warm
12 water at about 100°F) into a water-jacketed cooking apparatus. With mild agitation, desired
13 components (e.g., colorant, sodium chloride and potassium sorbate) are added to the water;
14 followed by the desired amount of starch-based material. Typically, the starch-based material is
15 sifted prior to use in order to avoid lump formation; and any powdered starch-based material is
16 scraped from the inner sidewalls of the cooker back into the liquid mixture. Then, the jacketed
17 tank hot water circulation system is set at a desired temperature (e.g., about 150°F). When the
18 slurry reaches a predetermined temperature (e.g., about 130°F), a recirculating pump can be used
19 to recirculate the aqueous slurry of starch-based material. A propeller type of mixer (e.g.,
20 operated at about 100 rpm to about 300 rpm, often about 200 rpm to about 250 rpm) can be used
21 to provide a shearing type of mixing to that slurry. The jacketed tank hot water circulation
22 system then is set at a desired temperature (e.g., about 190°F to about 200°F); and the slurry is
23 cooked further. Cooking is continued at least until the slurry reaches a temperature at which the
24 starch-based material undergoes hydration, and hence commences to behave as a gel. Such a
25 cooking time can occur over a time period that can vary; but typically, the heating rate is such
26 that the slurry reaches a temperature sufficient for the starch-based material to commence
27 forming a gel within about 30 to about 90 minutes. As a result, the slurry commences to exhibit
28 the behavior of as paste. The temperature at which the starch-based material undergoes
29 hydration can vary depending upon factors such as the selection of the particular starch-based
30 material; but typically the slurry is heated to a temperature of at least about 150°F, and frequently
31 the slurry is not heated to a temperature of above about 200°F. For example, for one type of

1 starch-based material, the slurry is heated and maintained at about 170°F to about 180°F; and for
2 another type of starch-based material, the slurry is heated and maintained at about 190°F to about
3 195°F. The manner by which the slurry is maintained at the elevated temperature can vary (e.g.,
4 the jacketed tank hot water flow can be cycled on and off in order to maintain the starch-based
5 slurry, which has the form of a paste, at within a desired temperature range for a desired period
6 of time). Typically, slurries of larger volume are maintained at elevated temperature for longer
7 periods of time than are slurries of smaller batch size. The time period over which the slurry is
8 maintained at the elevated temperature typically is that period over which the starch-based
9 material undergoes a desired degree of hydration. Typically, for slurries having volumes of less
10 than about 20 liters, that period does not exceed about 30 minutes, and often that period does not
11 exceed about 20 minutes. Then, the resulting paste is cooled. For example, ambient temperature
12 water is circulated through the jacketed tank to cool the starch-based paste below a desired
13 temperature (e.g., to about 140°F, or less). Typical formulations display viscosities that increase
14 with decreasing temperature (e.g., viscosities of about 60,000 centipoise to about 150,000
15 Brookfield centipoise at 25°C), making it desirable for the starch-based paste to be handled in a
16 more liquid form while at an elevated temperature. The resulting starch-based paste then can be
17 used virtually immediately to apply a pattern to a wrapping material; or the paste so
18 manufactured can be held and transferred (e.g., pumped) into a suitable container for storage,
19 shipping and later use.

20 Another method for cooking a starch-based paste formulation can involve the use of an
21 inline steam injection cooker. A suitable aqueous starch-based formulation can be heated and
22 mixed using such a cooker; and control of the heating and cooling rates of the formulation can be
23 achieved through appropriate means (e.g., through use of an inline heat exchange system).

24 Mixtures of starch-based materials can be used to achieve formulations having relatively
25 high solids contents and reduced solvent contents. Raw or uncooked starch-based materials can
26 be incorporated into those formulations. Thin boiling starch-based materials can be incorporated
27 into those formulations. Mixtures of starch-based materials, and certain additive materials, such
28 as oils and surfactants (e.g., coconut oil or potassium stearate), can be incorporated into the
29 formulation in relatively small amounts; and as such, formulations can exhibit reduced
30 propensities to retrograde.

1 Suitable exemplary starch-based formulations can be provided by cooking an aqueous
2 slurry of a waxy maize-based, modified starch; a low molecular weight dextrin that is soluble in
3 cold water; and optionally other suitable additives; to provide a formulation exhibiting a medium
4 viscosity to high viscosity. Preferred waxy maize-based modified starches are cross-linked
5 starch-based materials; and exemplary waxy maize-based modified starches are available as
6 Novation 9230, National 465 and WNA from National Starch and Chemical Company. The
7 amount of cross-linked starch-based material within such a formulation can vary; but typically
8 can be in the range of about 5 percent to about 25 percent, based on the total weight of the
9 formulation. The cross-linked starch-based material can act to provide a semi-paste-like to
10 paste-like viscosity to the formulation, and can impart a desirable rheology to the formulation.
11 As such, preferred formulations exhibit desirable shear resistance, and hence, do not exhibit a
12 propensity to shear thin (and hence, splatter or streak) when applied to a continuous strip of
13 paper web using the types of application apparatus that have been described previously.
14 Exemplary cold water soluble dextrin starch-based materials are available as N-Tack, Versa
15 Sheen and Crystal Tex 627 from National Starch and Chemical Company. The amount of cold
16 water soluble dextrin within the formulation can vary; but typically can be in the range of about
17 10 percent to about 35 percent, based on the total weight of the formulation. The cold water
18 soluble dextrin material can impart a Newtonian rheology, and some degree of viscosity stability,
19 to the formulation over the intended shelf life of the formulation (e.g., more than about 5 days,
20 and until the formulation is applied to the wrapping material).

21 One suitable formulation for an additive material for a paper web is a starch-based
22 aqueous formulation. A representative formulation includes about 10 weight percent sodium
23 chloride, about 0.5 weight percent potassium sorbate, about 35 weight percent oxidized tapioca
24 starch available as Flo-Max 8 from National Starch & Chemical Company, about 20 weight
25 percent calcium carbonate, and about 34.5 weight percent water. Such a formulation exhibits a
26 Brookfield viscosity of about 1,000 centipoise, at 25°C. If desired, the formulation can contain
27 dyes or pigments for aesthetic purposes or to facilitate automated inspection of paper wrapping
28 materials to which the formulation is applied. Such a formulation is particularly suitable for use
29 with an application system of the type described previously with reference to Figures 3 and 4.

30 Another suitable formulation for an additive material for a paper web is a starch-based
31 aqueous formulation. A representative formulation includes about 10 weight percent sodium

1 chloride, about 0.5 weight percent potassium sorbate, about 40 weight percent oxidized tapioca
2 starch available as Flo-Max 8 from National Starch & Chemical Company, and about 49.5
3 weight percent water. Preferably, the mixture is heated at an elevated temperature (e.g., about
4 170°F) for a period of time (e.g., about 10 minutes) sufficient to result in the formation of a
5 desirable paste. The viscosity of such a formulation gradually increases over time after initial
6 manufacture. After manufacture and storage, such a formulation exhibits a Brookfield viscosity
7 in the range of about 200,000 centipoise to about 2,000,000 centipoise, at 25°C. If desired, the
8 formulation can contain dyes or pigments for aesthetic purposes or to facilitate automated
9 inspection of paper wrapping materials to which the formulation is applied. Such a formulation
10 is particularly suitable for use with an application system of the type described previously with
11 reference to Figures 5-7.

12 Another suitable formulation for an additive material for a paper web is a starch-based
13 aqueous formulation. A representative formulation includes about 10 weight percent sodium
14 chloride, about 40 weight percent oxidized tapioca starch available as Flo-Max 8 from National
15 Starch & Chemical Company, and about 50 weight percent water. Preferably, the mixture is
16 heated at an elevated temperature (e.g., about 165°F) for a short period of time (e.g., about 10
17 minutes). Such a formulation exhibits an initial Brookfield viscosity in the range of about 2,000
18 centipoise to about 10,000 centipoise, and often about 3,000 to about 6,000 centipoise (at 25°C).
19 The viscosity of such a formulation can have a tendency to increase over time after initial
20 manufacture; and typically can increase to over 100,000 centipoise (at 25°C). The typical shelf
21 life of such a formulation is up to about 2 weeks, after which the formulation becomes very
22 thick. If desired, the formulation can contain dyes or pigments for aesthetic purposes or to
23 facilitate automated inspection of paper wrapping materials to which the formulation is applied.
24 Surfactants and soaps also can be incorporated into such a formulation, in order to assist in
25 retarding viscosity growth over time. For such a type of formulation, it is desirable to employ
26 the formulation such that the solids content thereof is at least in the range of about 44 to about 47
27 weight percent. Such a formulation is particularly suitable for use with an application system of
28 the type described previously with reference to Figure 23.

29 Another suitable formulation for an additive material for a paper web is a starch-based
30 aqueous formulation. A representative formulation includes about 5 weight percent sodium
31 chloride, about 0.5 weight percent potassium sorbate, about 49.75 weight percent oxidized

1 tapioca starch available as Flo-Max 8 from National Starch & Chemical Company, about 0.25
2 weight percent colorant, and about 44.5 weight percent water. Preferably, the mixture is heated
3 at an elevated temperature (e.g., about 170°F) for a period of time (e.g., about 10 minutes)
4 sufficient to result in the formation of a desirable paste. After manufacture and storage, such a
5 formulation exhibits a Brookfield viscosity of about 200,000 centipoise (at 25°C), and a pH of
6 about 5.0. The viscosity of such a formulation gradually increases over time after initial
7 manufacture. Within about 24 hours after manufacture, the formulation exhibits a viscosity of
8 about least about 200,000 centipoise. However, the formulation can be stored for about 10 days
9 before reaching a viscosity above about 2,000,000 centipoise (at 25°C). The formulation
10 contains colorant for aesthetic purposes or to facilitate automated inspection of paper wrapping
11 materials to which the formulation is applied. Such a formulation is particularly suitable for use
12 with an application system of the type described previously with reference to Figures 5-7. The
13 formulation can exhibit a Brookfield viscosity of about 200,000 centipoise to about 700,000
14 centipoise, at 25°C, over a 24 hour period.

15 Another suitable formulation for an additive material for a paper web is a starch-based
16 aqueous formulation. A representative formulation includes about 10 weight percent sodium
17 chloride, about 40 weight percent oxidized tapioca starch available as Flo-Max 8 from National
18 Starch & Chemical Company, about 0.25 weight percent colorant, and about 49.75 weight
19 percent water. Preferably, the mixture is heated at an elevated temperature (e.g., about 170°F)
20 for a period of time (e.g., about 10 minutes) sufficient to result in the formation of a paste. After
21 manufacture, the formulation exhibits a Brookfield viscosity of about 2,000 centipoise to about
22 4,000 centipoise, at 25°C. After storage for about 7 days, such a formulation exhibits a
23 Brookfield viscosity in the range of about 40,000 centipoise to about 100,000 centipoise, at 25°C.
24 The viscosity of such a formulation gradually increases over time after initial manufacture. The
25 formulation can be stored for about 90 days and still retain the properties of a smooth paste.
26 Soon after manufacture, such a formulation is particularly suitable for use with an application
27 system of the type described previously with reference to Figure 23. After storage for an
28 appropriate period, such a formulation is particularly suitable for use with an application system
29 of the type described previously with reference to Figures 5-7.

30 Another suitable formulation for an additive material for a paper web is a starch-based
31 aqueous formulation. A representative formulation includes about 5 weight percent sodium

1 chloride, about 0.5 weight percent potassium sorbate, about 35 weight percent oxidized waxy
2 maize corn starch available as Flokote 64 Starch from National Starch & Chemical Company,
3 and about 59.75 weight percent water. Preferably, the mixture is heated at an elevated
4 temperature (e.g., about 180°F) for a period of time (e.g., about 10 minutes) sufficient to result in
5 the formation of a desirable paste. After manufacture and storage for about 2 days, such a
6 formulation exhibits a Brookfield viscosity of about 200,000 centipoise, at 25°C.

7 Another suitable formulation for an additive material for a paper web is a starch-based
8 aqueous formulation. A representative formulation includes about 5 weight percent sodium
9 chloride, about 0.5 weight percent potassium sorbate, about 35 weight percent oxidized tapioca
10 starch available as Flo-Max 8 from National Starch & Chemical Company, and about 59.5
11 weight percent water. Preferably, the mixture is heated at an elevated temperature (e.g., about
12 170°F) for a period of time (e.g., about 10 minutes) sufficient to result in the formation of a
13 desirable paste. After manufacture and storage for about 30 days, such a formulation exhibits a
14 Brookfield viscosity of about 200,000 centipoise, at 25°C. The viscosity of such a formulation
15 gradually increases over time after initial manufacture. The formulation can be stored for about
16 5 months and still retain the properties of a smooth paste.

17 Another suitable formulation for an additive material for a paper web is a starch-based
18 aqueous formulation. A representative formulation includes about 5 weight percent sodium
19 chloride, about 0.25 weight percent potassium sorbate, about 10 weight percent modified waxy
20 maize available as WNA from National Starch & Chemical Company, about 30 weight percent
21 dextrin refined from tapioca starch available as Crystal Tex 627 from National Starch &
22 Chemical Company, and about 54.75 weight percent water. Preferably, the mixture is heated at
23 an elevated temperature (e.g., about 180°F to about 190°F) for a period of time (e.g., about 10
24 minutes to about 30 minutes) sufficient to result in the formation of a desirable paste. After
25 manufacture, such a formulation exhibits a Brookfield viscosity of about 50,000 centipoise to
26 about 200,000 centipoise, at 25°C. The viscosity of such a formulation gradually increases over
27 time after initial manufacture. The formulation can be stored for about 2 weeks and still retain
28 the properties of a smooth paste.

29 Another representative formulation for an additive material for a paper web is a starch-
30 based aqueous formulation. A representative formulation includes about 9.5 weight percent
31 sodium chloride, about 0.5 weight percent potassium sorbate, about 42.9 weight percent oxidized

1 tapioca starch available as Flo-Max 8 from National Starch & Chemical Company, about 0.2
2 weight percent colorant, about 19 weight percent calcium carbonate particles, and about 27.9
3 weight percent water. Preferably, the mixture is heated at an elevated temperature (e.g., about
4 170°F) for a period of time (e.g., about 10 minutes) sufficient to result in the formation of a
5 desirable paste. After manufacture such a formulation has the form of a thick paste, and the
6 viscosity of such a formulation gradually increases over time after initial manufacture.

7 Another representative formulation for an additive material for a paper web is a starch-
8 based aqueous formulation. A representative formulation includes about 10 weight percent
9 sodium chloride, about 0.5 weight percent potassium sorbate, about 40 weight percent oxidized
10 tapioca starch available as Flo-Max 8 from National Starch & Chemical Company, about 0.2
11 weight percent colorant, about 10 weight percent corn syrup, and about 39.3 weight percent
12 water. Preferably, the mixture is heated at an elevated temperature (e.g., about 170°F) for a
13 period of time (e.g., about 10 minutes) sufficient to result in the formation of a desirable paste.
14 After manufacture such a formulation has the form of a thick paste, and the viscosity of such a
15 formulation gradually increases over time after initial manufacture.

16 Coating formulations, such as the types of water-based coating formulations desired
17 hereinbefore, most preferably are subjected to drying conditions after those formulations have
18 been applied to a suitable substrate, such as a continuous strip of paper web of wrapping
19 material. Preferably, sufficient solvent (e.g., water) is removed from the formulation after that
20 formulation has been applied to the wrapping material such that the additive material that
21 remains in contact with the wrapping material does not exhibit a sticky or tacky character or
22 nature. Preferably, sufficient solvent (e.g., water) is removed from the formulation after that
23 formulation has been applied to the wrapping material such that the additive material that
24 remains in contact with the wrapping material exhibits a solvent (e.g., moisture) content of less
25 than about 10 percent, more preferably less than about 8 percent, based on the weight of the
26 additive material that remains in contact with the wrapping material. Typically, sufficient
27 solvent (e.g., water) is removed from the formulation after that formulation has been applied to
28 the wrapping material such that the additive material that remains in contact with the wrapping
29 material exhibits a solvent (e.g., moisture) content of about 4 percent to about 6 percent, based
30 on the weight of the additive material that remains in contact with the wrapping material.

1 The amount of coating formulation that is applied to the paper wrapping material can
2 vary. Typically, coating of the wrapping material provides a coated wrapping material having an
3 overall dry basis weight (i.e., the basis weight of the whole wrapping material, including coated
4 and uncoated regions) of at least about 1.05 times, often at least about 1.1 times, and frequently
5 at least about 1.2 times, that of the dry basis weight of that wrapping material prior to the
6 application of coating thereto. Generally, coating of the wrapping material provides a coated
7 paper having an overall dry basis weight of not more than about 1.5 times, typically about 1.4
8 times, and often not more than about 1.3 times, that of the dry basis weight of the wrapping
9 material that has the coating applied thereto. Typical overall dry basis weights of those wrapping
10 materials are about 20 g/m² to about 40 g/m²; preferably about 25 g/m² to about 35 g/m². For
11 example, a paper wrapping material having a dry basis weight of about 25 g/m² can be coated in
12 accordance with the present invention to have a resulting overall dry basis weight of 26 g/m² to
13 about 38 g/m², frequently about 26.5 g/m² to about 35 g/m², and often about 28 g/m² to about 32
14 g/m².

15 The dry weights of the coated regions of wrapping material of the present invention can
16 vary. For wrapping materials that are used for the manufacture of cigarettes designed to meet
17 certain cigarette extinction test criteria, it is desirable that the wrapping materials have sufficient
18 coating formulation applied thereto to in the form of appropriately shaped and spaced bands in
19 order that the dry weight of additive material applied to those wrapping materials totals at least
20 about 1 pound/ream, often at least about 2 pounds/ream, and frequently at least about 3
21 pounds/ream; while the total dry weight of that applied additive material normally does not
22 exceed about 10 pounds/ream.

23 Typical coated regions of paper wrapping materials of the present invention that are
24 suitable for use as the circumscribing wrappers of tobacco rods for cigarettes have inherent
25 porosities that can vary. Typically, the inherent porosities of the coated regions of the wrapping
26 materials are less than about 8.5 CORESTA units, usually are less than about 8 CORESTA units,
27 often are less than about 7 CORESTA units, and frequently are less than about 6 CORESTA
28 units. Typically, the inherent porosities of the coated regions of the wrapping materials are at
29 least about 0.1 CORESTA unit, usually are at least about 0.5 CORESTA unit, often are at least
30 about 1 CORESTA unit. Preferably, the inherent porosities of the coated regions of the
31 wrapping materials, particularly those wrapping materials that are used for the manufacture of

1 cigarettes designed to meet certain cigarette extinction test criteria, are between about 0.1
2 CORESTA unit and about 4 CORESTA units.

3 The paper wrapping material of the present invention can have can be coated in patterns
4 having predetermined shapes. The coating can have the form of bands, cross directional lines or
5 bands (including those that are perpendicular or at angles to the longitudinal axis of the wrapping
6 material), stripes, grids, longitudinally extending lines, circles, hollow circles, dots, ovals,
7 checks, spirals, swirls, helical bands, diagonally crossing lines or bands, triangles, hexagonals,
8 honeycombs, ladder-type shapes, zig zag shaped stripes or bands, sinusoidal shaped stripes or
9 bands, square wave shaped stripes or bands, patterns composed of coated regions that are
10 generally "C" or "U" shaped, patterns composed of coated regions that are generally "E" shaped,
11 patterns composed of coated regions that are generally "S" shaped, patterns composed of coated
12 regions that are generally "T" shaped, patterns composed of coated regions that are generally
13 "V" shaped, patterns composed of coated regions that are generally "W" shaped, patterns
14 composed of coated regions that are generally "X" shaped, patterns composed of coated regions
15 that are generally "Z" shaped, or other desired shapes. Combinations of the foregoing shapes
16 also can used to provide the desired pattern. Preferred patterns are cross directional lines or
17 bands that are essentially perpendicular to the longitudinal axis of the wrapping material.

18 The relative sizes or dimensions of the various shapes and designs can be selected as
19 desired. For example, shapes of coated regions, compositions of the coating formulations, or
20 amounts or concentrations of coating materials, can change over the length of the wrapping
21 material. The relative positioning of the printed regions can be selected as desired. For example,
22 wrapping materials that are used for the production of cigarettes designed to meet certain
23 cigarette extinction test criteria, the pattern most preferably has the form of spaced continuous
24 bands that are aligned transversely or cross directionally to the longitudinal axis of the wrapping
25 material. However, cigarettes can be manufactured from wrapping materials possessing
26 discontinuous bands positioned in a spaced apart relationship. For wrapping materials of those
27 cigarettes, it is most preferred that discontinuous bands (e.g., bands that are composed of a
28 pattern, such as a series of dots, grids or stripes) cover at least about 70 percent of the surface of
29 the band area or region of the wrapping material.

30 Preferred wrapping materials possess coatings in the form of bands that extend across the
31 wrapping material, generally perpendicular to the longitudinal axis of the wrapping material.

1 The widths of the individual bands can vary, as well as the spacings between those bands.
2 Typically, those bands have widths of at least about 0.5 mm, usually at least about 1 mm,
3 frequently at least about 2 mm, and most preferably at least about 3 mm. Typically, those bands
4 have widths of up to about 8 mm, usually up to about 7 mm. Preferred bands have widths of
5 about 4 mm to about 7 mm, and often have widths of about 6 mm to about 7 mm. Such bands
6 can be spaced apart such that the spacing between the bands is at least about 10 mm; often at
7 least about 15 mm, frequently at least about 20 mm, often at least about 25 mm, in certain
8 instances at least about 30 mm, and on occasion at least about 35 mm; but such spacing usually
9 does not exceed about 50 mm. For certain preferred wrapping materials, the bands are spaced
10 apart such that the spacing between the bands is about 15 mm to about 25 mm.

11 There are several factors that determine a specific coating pattern for a wrapping material
12 of the present invention. It is desirable that the components of the coating formulations applied
13 to wrapping materials not adversely affect to any significant degree (i) the appearance of
14 cigarettes manufactured from those wrapping materials, (ii) the nature or quality of the smoke
15 generated by those cigarettes, (iii) the desirable burn characteristics of those cigarettes, or (iv) the
16 desirable performance characteristics of those cigarettes. It also is desirable that wrapping
17 materials having coating formulations applied thereto not introduce undesirable off-taste, or
18 otherwise adversely affect the sensory characteristics of the smoke generated by cigarettes
19 manufactured using those wrapping materials. In addition, preferred cigarettes of the present
20 invention do not have a tendency to undergo premature extinction, such as when lit cigarettes are
21 held in the smoker's hand or when placed in an ashtray for a brief period of time.

22 Cigarettes designed to meet certain cigarette extinction test criteria can be produced from
23 wrapping materials of the present invention. Banded regions on a wrapping material are
24 produced using additive materials that are effective in reducing the inherent porosity of the
25 wrapping material in those regions. Film-forming materials and fillers applied to the wrapping
26 material in those banded regions are effective in increasing the weight of the wrapping material
27 in those regions. Filler materials that are applied to the wrapping material in those banded
28 regions are effective in decreasing the burn rate of the wrapping materials in those regions.
29 Typically, when wrapping materials of relatively high inherent porosity are used to manufacture
30 cigarettes, those wrapping materials possess relatively high weight bands that introduce a
31 relatively low inherent porosity to the banded regions. Film-forming materials have a tendency

1 to reduce the porosity of the wrapping material, whether or not those materials are used in
2 conjunction with fillers. However, coatings that combine porosity reduction with added coating
3 weight to wrapping materials also are effective in facilitating extinction of cigarettes
4 manufactured from those wrapping materials. Low porosity in selected regions of a wrapping
5 material tends to cause a lit cigarette to extinguish due to the decrease in access to oxygen for
6 combustion for the smokable material within that wrapping material. Increased weight of the
7 wrapping material also tends to cause lit cigarette incorporating that wrapping material to
8 extinguish. As the inherent porosity of the wrapping material increases, it also is desirable to (a)
9 select a film-forming material so as to cause a decrease the inherent porosity of the coated region
10 of the wrapping material and/or (b) provide a coating that provides a relatively large amount of
11 added weight to the coated region of the wrapping material.

12 Paper wrapping materials of the present invention are useful as components of smoking
13 articles such as cigarettes. Preferably, one layer of the wrapping material of the present
14 invention is used as the wrapping material circumscribing the smokable material, and thereby
15 forming the tobacco rod of a cigarette. In one regard, it is preferable that the wrapping material
16 possesses the coated regions located on the "wire" side thereof, and the "wire" side of that
17 wrapping material forms the inner surface of the circumscribing wrapping material of the
18 tobacco rod. That is, when the wrapping material is used to manufacture a smokable rod, the
19 "wire side" major surface of the wrapping material that circumscribes the smokable material
20 faces that smokable material. Typically, the "felt" side of the wrapping material is used as the
21 visible outer surface of the tobacco rod. The terms "wire side" and "felt side" in referring to the
22 major surfaces of paper sheet are readily understood as terms of art to those skilled in the art of
23 paper and cigarette manufacture.

24 Cigarettes of the present invention can possess certain appropriately treated wrapping
25 materials of the present invention. The wrapping material can possess patterns of predetermined
26 shapes and sizes positioned at predetermined locations, and hence, cigarettes appropriately
27 manufactured from that wrapping material can possess patterns of predetermined shapes and
28 sizes positioned at predetermined locations on their smokable rods. The wrapping material can
29 possess patterns of predetermined composition positioned at predetermined locations, and hence,
30 cigarettes appropriately manufactured from that wrapping material can possess patterns of
31 predetermined composition positioned at predetermined locations on their smokable rods. The

1 foregoing types of patterns can introduce certain properties or behaviors to specific regions of
2 those smokable rods (e.g., the patterns can provide specific regions of increased weight,
3 decreased permeability and/or increased burn retardant composition to wrapping material). For
4 example, a wrapping material that possesses bands that surround the column of smokable
5 material of the smokable rod and that decrease the permeability of the wrapping material (e.g.,
6 the wrapping material can have bands applied thereto and the bands can be positioned thereon)
7 can be such that each acceptable smokable rod manufactured from that wrapping material can
8 possess at least two identical bands on the wrapping material surrounding the tobacco column,
9 and the spacing between the bands, measured from the inside adjacent edges of the bands, is no
10 less than 15 mm and no greater than 25 mm.

11 Cigarettes of the present invention possessing tobacco rods manufactured using certain
12 appropriately treated wrapping materials of the present invention, when tested using the
13 methodology set forth in the Cigarette Extinction Test Method by the National Institute of
14 Standards and Technology (NIST), Publication 851 (1993) using 10 layers of Whatman No. 2
15 filter paper, meet criteria requiring extinction of greater than about 50 percent, preferably greater
16 than about 75 percent, and most preferably about 100 percent, of cigarettes tested. Certain
17 cigarettes of the present invention possessing tobacco rods manufactured using certain
18 appropriately treated wrapping materials of the present invention, when tested using the
19 methodology set forth in the methodology set forth in ASTM Designation: E 2187-02b using 10
20 layers of Whatman No. 2 filter paper, meet criteria requiring extinction of greater than about 50
21 percent, preferably greater than about 75 percent, and most preferably about 100 percent, of
22 cigarettes tested. Preferably, each cigarette possesses at least one band located in a region of its
23 tobacco rod such that the band is capable of providing that cigarette with the ability to meet those
24 cigarette extinction criteria. For a tobacco rod of a particular length incorporating a wrapping
25 material possessing bands that are aligned transversely to the longitudinal axis of the wrapping
26 material in a spaced apart relationship, the ratio of the length of the tobacco rod to the sum of the
27 width of a band and the distance between the bands is 1 to 2, preferably about 1.1 to about 1.4,
28 and most preferably about 1.2.

29 Certain preferred cigarettes incorporate banded wrapping materials for the column of
30 smokable material. The wrapping material of each preferred smokable rod can possess at least
31 one band. Alternatively, the wrapping material of each preferred smokable rod can possess at

1 least two bands, and those bands can be virtually identical. The band spacing on the wrapping
2 material can vary. Typically, bands are spaced about 15 mm to about 60 mm apart, often about
3 15 mm to about 45 mm apart, and frequently about 15 mm to about 30 mm apart. For certain
4 preferred wrapping materials, smokable rods and cigarettes, the band spacing, measured from the
5 inside adjacent edges of the bands, is no less than 15 mm and no greater than 25 mm. Certain
6 cigarettes can possess bands that are spaced on the wrapping materials of those cigarettes such
7 that each cigarette possesses a band or bands of the desired configuration and composition in
8 essentially identical locations on each tobacco rod of each cigarette. For an exemplary full flavor
9 cigarette having a tobacco rod length of about 63 mm and a filter element length of about 21
10 mm, cross directional bands of about 6 mm width can be spaced at about 20 mm intervals on the
11 wrapping materials used to manufacture those cigarettes. Alternatively, for those types of
12 cigarettes, bands of about 4 mm width can be spaced at about 22 mm intervals on the wrapping
13 materials used to manufacture those cigarettes. Alternatively, for those types of cigarettes, bands
14 of about 6 mm width can be spaced at about 39 mm intervals. For an exemplary full flavor
15 cigarette having a tobacco rod length of about 70 mm and a filter element length of about 30
16 mm, cross directional bands of about 6 mm width can be spaced at about 44 mm intervals on the
17 wrapping materials used to manufacture those cigarettes. For an exemplary ultra low tar
18 cigarette having a tobacco rod length of about 57 mm and a filter element length of about 27
19 mm, cross directional bands of about 7 mm width can be spaced at about 20 mm intervals.
20 Alternatively, for those types of cigarettes, bands of about 6 mm width can be spaced at about 33
21 mm intervals, or at about 39 mm intervals, on the wrapping materials used to manufacture those
22 cigarettes. For an exemplary ultra low tar cigarette having a tobacco rod length of about 68 mm
23 and a filter element length of about 31 mm, cross directional bands of about 6 mm width can be
24 spaced at about 44 mm intervals on the wrapping materials used to manufacture those cigarettes.
25 Full flavor cigarettes are classified as those that yield about 14 mg or more of FTC "tar." Ultra
26 low tar cigarettes are classified as those that yield less than about 7 mg of FTC "tar." Those
27 cigarettes have tobacco rods having appropriate wrapping materials possessing bands composed
28 of appropriate amounts of appropriate components have the ability to meet the aforementioned
29 cigarette extinction criteria.

30 Cigarettes of the present invention can be manufactured from a variety of components,
31 and can have a wide range of formats and configurations. Typical cigarettes of the present

1 invention having cross directional bands applied to the wrapping materials of the tobacco rods of
2 those cigarettes (e.g., virtually perpendicular to the longitudinal axes of those cigarettes) have
3 static burn rates (i.e., burn rates of those cigarettes under non-puffing conditions) of about 50 to
4 about 60 mg tobacco rod weight per minute, in the non-banded regions of those cigarettes.
5 Typical cigarettes of the present invention having cross directional bands applied to the wrapping
6 materials of the tobacco rods of those cigarettes have static burn rates (i.e., burn rates of those
7 cigarettes under non-puffing conditions) of less than about 50 mg tobacco rod weight per minute,
8 preferably about 40 to about 45 mg tobacco rod weight per minute, in the banded regions of
9 those cigarettes.

10 The tobacco materials used for the manufacture of cigarettes of the present invention can
11 vary. Descriptions of various types of tobaccos, growing practices, harvesting practices and
12 curing practices are set for in *Tobacco Production, Chemistry and Technology*, Davis et al.
13 (Eds.) (1999). The tobacco normally is used in cut filler form (e.g., shreds or strands of tobacco
14 filler cut into widths of about 1/10 inch to about 1/60 inch, preferably about 1/20 inch to about
15 1/35 inch, and in lengths of about 1/4 inch to about 3 inches). The amount of tobacco filler
16 normally used within a cigarette ranges from about 0.6 g to about 1 g. The tobacco filler
17 normally is employed so as to filler the tobacco rod at a packing density of about 100 mg/cm³ to
18 about 300 mg/cm³, and often about 150 mg/cm³ to about 275 mg/cm³. Tobaccos can have a
19 processed form, such as processed tobacco stems (e.g., cut-rolled or cut-puffed stems), volume
20 expanded tobacco (e.g., puffed tobacco, such as propane expanded tobacco and dry ice expanded
21 tobacco (DIET)), or reconstituted tobacco (e.g., reconstituted tobaccos manufactured using
22 paper-making type or cast sheet type processes).

23 Typically, tobacco materials for cigarette manufacture are used in a so-called "blended"
24 form. For example, certain popular tobacco blends, commonly referred to as "American blends,"
25 comprise mixtures of flue-cured tobacco, burley tobacco and Oriental tobacco, and in many
26 cases, certain processed tobaccos, such as reconstituted tobacco and processed tobacco stems.
27 The precise amount of each type of tobacco within a tobacco blend used for the manufacture of a
28 particular cigarette brand varies from brand to brand. See, for example, *Tobacco Encyclopedia*,
29 Voges (Ed.) p. 44-45 (1984), Browne, *The Design of Cigarettes*, 3rd Ed., p.43 (1990) and
30 *Tobacco Production, Chemistry and Technology*, Davis et al. (Eds.) p. 346 (1999). Other
31 representative tobacco blends also are set forth in U.S. Patent Nos. 4,836,224 to Lawson et al.;

1 4,924,888 to Perfetti et al.; 5,056,537 to Brown et al.; 5,159,942 to Brinkley et al.; 5,220,930 to
2 Gentry; 5,360,023 to Blakley et al.; and 5,714,844 to Young et al.; US Patent Applications
3 2002/0000235; 2003/0075193; and 2003/0131859; PCT WO 02/37990; US Patent Application
4 Ser. Nos. 10/285,395, filed October 31, 2002 and 10/463,211, filed June 17, 2003; and Bombick
5 et al., *Fund. Appl. Toxicol.*, 39, p. 11-17 (1997); which are incorporated herein by reference.

6 If desired, in addition to the aforementioned tobacco materials, the tobacco blend of the
7 present invention can further include other components. Other components include casing
8 materials (e.g., sugars, glycerin, cocoa and licorice) and top dressing materials (e.g., flavoring
9 materials, such as menthol). The selection of particular casing and top dressing components is
10 dependent upon factors such as the sensory characteristics that are desired, and the selection of
11 those components will be readily apparent to those skilled in the art of cigarette design and
12 manufacture. See, Gutcho, *Tobacco Flavoring Substances and Methods*, Noyes Data Corp.
13 (1972) and Leffingwell et al., *Tobacco Flavoring for Smoking Products* (1972).

14 Smoking articles also can incorporate at least one flavor component within the side seam
15 adhesive applied to the wrapping material during the manufacture of the tobacco rods. That is,
16 for example, various flavoring agents can be incorporated in a side seam adhesive CS-2201A
17 available from R. J. Reynolds Tobacco Company, and applied to the seam line of the wrapping
18 material. Those flavoring agents are employed in order to mask or ameliorate any off-taste or
19 malodor provided to the smoke generated by smoking articles as a result of the use of the
20 wrapping materials of the present invention, such as those wrapping materials having coating
21 formulations incorporating certain cellulosic-based or starch-based components applied thereto.
22 Exemplary flavors include methyl cyclopentenolone, vanillin, ethyl vanillin, 4-
23 parahydroxyphenyl-2-butanone, *gamma*-undecalactone, 2-methoxy-4-vinylphenol, 2-methoxy-4-
24 methylphenol, 5-ethyl-3-hydroxy-4-methyl-2(5H)-furanone, methyl salicylate, clary sage oil and
25 sandalwood oil. Typically, such types of flavor components are employed in amounts of about
26 0.2 percent to about 6.0 percent, based on the total weight of the adhesive and flavor
27 components.

28 Cigarettes preferably have a rod shaped structure and a longitudinal axis. Such cigarettes
29 each have a column of smokable material circumscribed by wrapping material of the present
30 invention. Preferably, the wrapping material encircles the outer longitudinally extending surface
31 of the column of smokable material, and each end of the cigarette is open to expose the smokable

1 material. Exemplary cigarettes, and exemplary components, parameters and specifications
2 thereof, are described in U.S. Patent No. 5,220,930 to Gentry; PCT WO 02/37990 and U.S.
3 Patent Application 2002/0166563; which are incorporated herein by reference. Representative
4 filter element components and designs are described in Browne, *The Design of Cigarettes*, 3rd
5 Ed. (1990); *Tobacco Production, Chemistry and Technology*, Davis et al. (Eds.) 1999; US Patent
6 Nos. 4,508,525 to Berger; 4,807,809 to Pryor et al.; 4,920,990 to Lawrence et al.; 5,012,829 to
7 Thesing et al.; 5,025,814 to Raker; 5,074,320 to Jones, Jr. et al.; 5,101,839 to Jakob et al.;
8 5,105,834 to Saintsing et al.; 5,105,838 to White et al.; 5,271,419 to Arzonico et al.; 5,360,023 to
9 Blakley et al.; 5,595,218 to Koller et al.; 5,718,250 to Banerjee et al.; and 6,537,186 to Veluz; US
10 Patent Applications 2002/0014453; 2002/0020420; and 2003/0168070; US Patent Application
11 Serial No. 10/600,712, filed June 23, 2003, to Dube et al.; PCT WO 03/059096 to Paine et al.;
12 and European Patent No. 920816. Representative filter materials can be manufactured from tow
13 materials (e.g., cellulose acetate or polypropylene tow) or gathered web materials (e.g., gathered
14 webs of paper, cellulose acetate, polypropylene or polyester). Certain filter elements can have
15 relatively high removal efficiencies for selected gas phase components of mainstream smoke.

16 Although the present invention has been described with reference to particular
17 embodiments, it should be recognized that these embodiments are merely illustrative of the
18 principles of the present invention. Those of ordinary skill in the art of smoking article design
19 and manufacture will appreciate that the various systems, equipment and methods may be
20 constructed and implemented in other ways and embodiments. Accordingly, the description
21 herein should not be read as limiting the present invention, as other embodiments also fall within
22 the scope of the present invention.